TIME IN RETROSPECT: THE RECALL OF TEMPORAL INFORMATION IN VERY LONG TERM MEMORY

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Christopher D. B. Burt

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ABSTRACT

This thesis investigates the recall of temporal information in very long term memory, particularly event duration. Experiments 1 through 4 examine the estimation of public event duration, for example, how long the Falkland's war lasted. Subjects in Experiment 6, Part a, were asked to date events they had personally experienced (autobiographical events) and thus indicate the time elapsed since the event's occurrence. Subjects in this Experiment were also asked to recall other information about events, such as where they occurred: the event aspects 'what', 'where' and 'who' were used both as prompts to recall and as the aspects to be recalled. In Experiment 6, Part b, subjects estimated the duration of two types of autobiographical events: empty and filled duration events. Events typical of these two types of event are respectively, 'How long after you ordered the computer game did it arrive ?' and 'How long were you in hospital for ?'.

Experiment 6 employed a method new to memory research, the undirected-diary method. Diarists were used as subjects in this experiment. Their diary records, which were recorded with no prior knowledge of any possible use in research, were obtained and used as a source of information about events they had experienced, for example, the nature and actual duration of events was obtained for Experiment 6, Part b. Because of the development of a new method, Experiment 5, a survey of diarists, was conducted. The results of this survey are reported in Chapter 3, in which the undirected-diary method is compared to other methods used to investigate autobiographical memory. It is suggested that the undirected-diary method is a useful method, and one which overcomes a number of problems associated with the study of autobiographical memory.

Ornstein's (1969) 'storage size' model of duration estimation was examined in Experiment 2 and Experiment 6, Part b. In general, little support was found for this model and an alternative model was developed: the reconstructive model of duration estimation. Predictions made on the basis of this model were tested in Experiment 4, the results of which generally supported the model. Experiment 6, Part a, found results consistent with other studies of event dating and studies which have examined autobiographical memory. Absolute dating error increased and signed dating error varied systematically with retention interval. Recall of event aspect information varied systematically with the cues provided for recall and was interpreted within a uniqueness explanation of autobiographical memory organization.

CHAPTER 1

RETROSPECTIVE DURATION ESTIMATION: THE PHENOMENA UNDER INVESTIGATION

1.0 Introduction

Each of us has probably wondered at some point about the concept of time, most of us are certainly ruled by it. Our activities, in particular, are determined by it; it helps to be in the right place at the right time. At the universal level time is difficult to comprehend, stretching beyond our imagination; and yet our own time, our life, must be lived within a conceptualization of it, a sense of the past, present and future. One's conceptualization of these three temporal perspectives produces a sense of duration, or time in passing. The present is linked to both the past and the future by the concept of duration, which we regularly use to define the relationship between now and then. In order to do this one generally makes a duration estimate, and it is this process, duration estimation, that this thesis explores.

The psychological study of duration traditionally divides itself into, (a) the perception of duration, where an on-going event, whose elements are unquestionably linked, is perceived to have duration (e.g., watching a fall star); and (b) the estimation of duration where a single event, or two related events which occurred in the past, can be recalled as having a particular duration (Fraisse, 1984). Fraisse has suggested a further duration estimation/retrospective duration estimation distinction based on retention interval, that is the time elapsed between the experience of an interval or event and the estimation of its duration. Duration estimation occurs when, for example, "You go to see a friend who is not home, decide to wait, your friend soon arrives and asks you how long you have been waiting", or "You are watching a documentary on television, someone enters the room and asks you how long it has been on for". In both of these situations the estimate is made immediately after experiencing the interval or event. A retrospective duration estimate, on the other hand, is made when the duration estimate is of an event which did not occur in the immediate past.

Three definably different scenarios where retrospective duration estimates are requested can be defined: (a) where subjects are asked how long they engaged in some particular past activity, for example, "How long did you work at Mt. Cook last summer?"; (b) where the duration of an event that was not directly experienced is enquired about, for example, "How long were the Japanese climbers trapped on Mt. Cook?"; and (c) where the duration between a past event and the asking of the question is asked, for example, "How long is it since you left Mt. Cook?"

Although it can be argued that all duration estimates are retrospective in that they relate to an event that occurred in the past, in terms of Fraisse's operational distinction the focus of this thesis is retrospective duration estimation, specifically estimates made in the three scenarios described above. Duration estimation accuracy, the nature of estimation error and the strategies adopted by subjects when making a duration estimate are specifically considered. Because it is proposed that duration information is routinely recalled in everyday situations like those described above, everyday situations are used in the various studies. That is, every effort has been made to ensure that each experiment is ecologically valid, and that duration information is recalled under conditions typical of those encountered in everyday life.

The events described by scenario (a) have been referred to as 'time eras' (Reiser, Black & Kalamarides, 1986) and 'extendures' (Linton, 1986). These authors have examined the significance of such events in terms of memory organization, rather than the recall of associated duration information. Neisser (1986) has also discussed such events in terms of memory organization, stating that

> "the occurrence of two similar or related events creates an extended event that exists in its own right . . . each of the separate events leaves its own trace in memory, but there is also the trace of the the pair itself." (p. 78)

Neisser's event description complements the above example of a scenario (a) event, and indicates that such events can be divided into two categories; events, such as going on a holiday or working at a job, which are basically a continuous succession of related events, and events, such as ordering something by mail and receiving it, or buying a raffle ticket and finding out the

result, which are simply two related events separated by a succession of unrelated events. In terms of the amount of associated information which is acquired during these two types of events, and using traditional duration estimation research terminology, the former might be described as a 'filled duration event' and the later an 'empty duration event'. Experiment 6, Part b, of this thesis examines retrospective duration estimation of these two types of duration event.

Scenario (b) events are continuously occurring around us and are often brought to our attention by the media. They are clearly distinguished from scenario (a) events by the fact that they are experienced indirectly via the media, rather than personally experienced. The example used above: "How long were the Japanese climbers trapped on Mt. Cook?" describes an event which might have received extensive media coverage relating to the fact that climbers were overdue, the resulting search, and the subsequent rescue. The media coverage of the event essentially defines its duration. Experiments 1 through 4 of this thesis explore subjects' ability to estimate the duration of such public events.

A response made under scenario (c) conditions ("How long is it since you left Mt. Cook?") is considered by some authors to be a retrospective duration estimate (e.g., Ferguson & Martin, 1983; Fraisse, 1984; Furlong, 1951). However, in this situation the duration estimate equals the retention interval (the time elapsed since the events occurrence), and it is probable that the cognitive processes involved when generating the duration estimate are different from those adopted in scenario (a) and (b) situations. The scenario (c) situation is essentially an event dating problem. That is, the question "How long is it since you left Mt. Cook?" can be easily transformed into "When did I leave Mt. Cook?" and "What is the duration between that date and the present date?". In accordance with this, the recall of duration information in scenario (c) situations is examined in this thesis (Experiment 6, Part a), indirectly via an examination of event dating: subjects were asked when an event occurred, rather than how long ago it occurred.

Adopting an event dating procedure in Experiment 6, Part a, as opposed to asking how long ago questions, allowed the results to be compared with other studies on event dating. Furthermore, because some event dating studies have specifically investigated the effect of event memory, event memory was also examined in Experiment 6, Part a: subjects' were asked to

recall who was involved in the event, where it occurred and what occurred. A procedure similar to that used by Wagenaar (1986) was employed. This allowed event memory to be assessed objectively, and scaled.

In general the duration estimation experiments reported in this thesis are unique. In relation to Experiments 1 through 4, no similar study of the estimation of public event duration was found by this author. Similarly no reference to a study such as Experiment 6, Part b, (retrospective duration estimation of naturally occurring personal events) was found in the duration estimation research literature, although some data relating to these types of estimates has been reported in relation to other types of research. Furthermore, both parts of Experiment 6 are unique in that subjects' diaries were used to verify that they had experienced specific events and to obtain details of the events (e.g., the actual duration, the date, who was involved, where it occurred). Because Experiment 6 uses a new method, Chapter 3 and Experiment 5 (a survey) are devoted to an assessment of its research potential. Specifically, Experiment 5 examines the behaviour of diary-keeping and the implications this has for the use of diaries in autobiographical memory research.

The following sections have three aims: first to review the relevant findings in relation to duration estimation and event dating which can be compared with the results obtained in this thesis. Secondly, to illustrate why the methods used in this thesis were adopted and why they should be used to study duration estimation. Finally, to illustrate why the results obtained in this thesis might be different from those traditionally obtained in duration estimation research.

1.1 Duration Estimation Research

Research on duration estimation has generally used very short actual durations, typically less than one minute. The interval to be estimated is invariably presented to the subject under controlled laboratory conditions using, for example, the onset and termination of a light (e.g., Rule & Curtis, 1985) or tone (e.g., Kane & Lown, 1986) to define the interval. Often immediately after the presentation of the stimulus interval, but sometimes after a brief delay (retention interval), the subject is asked to estimate verbally or perhaps to reproduce the duration of the experienced interval. There are a

few studies which have adopted slightly different procedures, but in general this procedural description is applicable to the majority of duration estimation research (Eisler, 1976; Fraisse, 1984).

There are obvious parallels between the duration estimation research methodology described above and the list-learning (Ebbinghaus type) experiments (Ebbinghaus, 1913) traditionally used to investigate various aspects of memory encoding, storage and retrieval. In both types of experiment, the stimulus material, the learning or stimulus acquisition context, retention interval and, to some extent, the dependent measures used can be described as artificial. That is, they do not represent the characteristics of the environment in which the systems that are being investigated (duration estimation and memory) typically operate, nor how the systems themselves normally function in the environment. Traditional laboratory studies may, therefore, produce results which only allow the experimenter to model the functioning of these systems under highly artificial laboratory conditions.

The reliability of Ebbinghaus type memory experiments is rarely questioned, but the issue of their ecological validity has been raised by a number of authors (e.g., Baddeley, 1982; Bahrick, 1979; Bahrick & Karis, 1982; Bruce, 1985a, 1985b; Edwards & Middleton, 1987; Hirst & Levine, 1985; Lockart, 1979; Neisser, 1976, 1978, 1982, 1985; Rubin, 1986). Neisser argues that the traditional approach should be completely rejected in favour of the investigation of memory under natural conditions. Other authors have not been so explicit in their demands, but have vigorously criticized various aspects of Ebbinghaus methodology.

The ecological validity of the methods used in duration estimation research does not, however, appear to have been questioned at all, although the problems raised in relation to Ebbinghaus type memory research are equally applicable to most studies of duration estimation. Those problems relate to every aspect of Ebbinghaus methodology, and are discussed in the following sections in relation to duration estimation research.

1.1.1 The Interval To Be Estimated

The rationale behind the use of meaningless material such as letter sequences, lists of words or paired associates as the stimuli to be remembered

in Ebbinghaus type memory experiments is to control for the confounding effect of previously acquired information (elaboration) and the use of inferential or reconstructional processes at the recall or recognition phase (Marshall & Fryer, 1978). However, in eliminating the possibility of associating the material to be remembered during its initial presentation with existing knowledge, and the subsequent use of these associations and other knowledge when trying to retrieve the material, the researcher is largely ignoring the system which is the object of study, since memory normally is of meaningful material.

The same objection might be made for duration estimation: intervals of time or durations that are usually recalled are generally associated with meaningful experiences or events. It can reasonably be argued that flashes of light or a burst of tone do not constitute meaningful units of information of the same kind as, for example, leaving for and returning from a holiday. Not all duration estimation research has, however, defined the interval to be estimated using flashes of light or bursts of tone. Other stimuli employed include clicks (e.g., Doehring, 1961; Jones & MacLean, 1966; McConchie & Rutschmann, 1971; Ross & Katchmar, 1951), electrical current (e.g., Ekman, Frankenhaeuser, Levander & Mellis, 1966; Hawkes, 1961a, 1961b), a moving spot (e.g., Mashhour, 1964; Rachlin, 1966), music (e.g., Kowal, 1987; Richards, 1964), time under hypnosis (e.g., Brown, 1984; Schwartz, 1978; St Jean & Robertson, 1986), performance of a mathematical task (e.g., Burnside, 1971), an action video (e.g., bank robbery - Loftus, Schooler, Boone & Kline, 1987; Marshall, 1966), and a staged assault on a university campus (Buckhout, 1977). Obviously some of the above studies have had subjects estimate the duration of meaningful events, although it is questionable whether the duration of such events is normally recalled in the course of everyday life.

The use of reconstruction (the ability to infer something on the basis of past experience rather than actually recalling it) when estimating an event's duration has not been widely investigated, the exception being studies which have examined event dating; as already noted, event dating can be used to produce a duration estimate. Event dating studies (see Section 1.3) have found ample evidence that dates are often reconstructed rather than recalled. There is also evidence that suggests recall in general is often reconstructive (e.g., Bartlett, 1932; Loftus, 1975). There is, therefore, every reason to expect that reconstructive processes may be involved when estimating event

duration. Indeed, in some situations a duration estimate may have to be reconstructed; for example, a painting contractor may be asked "How long it will take to paint a particular house?", or a park ranger "How long it will take to tramp to a certain mountain hut?" from a specified point. Under these conditions a duration estimate must be either a guess, or an inference. As a highly inaccurate guess may have serious consequences in these situations, it is probable the required duration estimate is inferred on the basis of past experience. If reconstruction is used when retrospectively estimating an event's duration, studies which attempt to explain the estimation process and that deny the opportunity of using this recall strategy, may produce misleading results.

Elaboration at encoding or 'depth of processing' (Craik & Lockhart, 1972), in contrast to reconstruction, has been explicitly considered in relation to duration estimation (e.g., Block & Reed, 1978, Experiment 1). Such studies have examined event-memory hypotheses which argue that duration estimation is mediated by stored and retrievable information associated with the experienced interval. That is, duration estimates are directly related to the information "remaining in storage" (Ornstein, 1969, p. 104), or "the number of events stored and retained" (Block, 1974, p. 158) from an interval being estimated.

Depth of processing has been manipulated using traditional memory research methodology. For example, Block and Reed (1978) had subjects either count the number of words with a particular type-style (e.g., upper-case), or the number of words that belonged to a specific category (e.g., body parts) that were presented during the interval to be estimated. Structured level processing (counting words in a particular type-style) was considered to be 'shallow', with little elaboration within the existing memory structure, while semantic level processing (counting words that belonged to a specific category) was considered to be 'deep'. Level of processing was found to affect memory of the material presented during the interval to be estimated, but not estimated duration.

Another depth of processing distinction with perhaps more ecological validity might be to consider events directly experienced by an individual as 'deep'; and those indirectly experienced via the media as 'shallow'. This distinction is similar to that between the events described by scenario (a) in Section 1.0 (e.g., "How long did you work at Mt. Cook last summer?"), and

those described by scenario (b) (e.g., "How long were the Japanese climbers trapped on Mt. Cook?"). The former type of event, a personally experienced event, is likely to be more elaborately encoded within the memory structure. Evidence for this greater elaboration was reported by Kuiper and Rogers (1979) where other-referent decisions were found to produce slower reaction times that self-referent decisions. Loftus and Fathi (1985) also noted that self-related information is "more affect-laden, more familiar, more robust and more complex" (p. 294).

Despite the artificial nature of the interval to be estimated that is typically used in duration estimation research, numerous studies have reported a significant effect on duration estimates when this variable is manipulated. An interval which contains complex, unfamiliar, less predictable or more numerous components is estimated to be significantly longer than an interval of similar duration containing simpler (e.g., Block, 1978, Experiment 2; Ornstein, 1969; Schiffman & Bobko, 1974), more familiar (e.g., Avant & Lyman, 1975), more predictable (e.g., Frankenhaeuser, 1959; Ornstein, 1969), or fewer components (e.g., Buffardi, 1971; Burnside, 1971; Fraisse, 1963; Frankenhaeuser, 1959; Hall & Jastrow, 1886; Ornstein, 1969; Poynter & Homa, 1983; Roeloefs & Zeeman, 1951; Schiffman & Bobko, 1977; Thomas & Brown, 1974). The latter finding, relating to the number of components within the interval, is frequently referred to as the 'filled-duration illusion' and has been extensively investigated.

As well as the above findings, the extent of the filled-duration illusion has been reported to vary in relation to the position of intervening elements within the interval (e.g., Buffardi, 1971) and the actual durations used (e.g., Ihle & Wilsoncroft, 1983). Although a number of studies have failed to find a filled-duration effect (e.g., Jones & Natale, 1973; Kane & Lown, 1986), the number of studies that have, suggests that it is a reasonably robust effect. However, the procedures used to define filled and empty durations must be questioned. Gilliland, Hofledt and Eckstrand (1946) noted that the stimuli typically used to fill the interval (e.g., flashes of light, bursts of tone) may have little attentional value for a subject, while the subject's thoughts and fantasies during an unfilled interval may constitute important interval filling.

In line with the present discussion, a more ecologically valid filled/empty duration interval distinction might be between the two types of

scenario (a) events described in Section 1.0. As already noted, events such as these are used in Experiment 6, Part b, as filled and empty intervals.

The stimulus interval's actual duration has also been found to affect duration estimation. Many studies have sought to determine whether the estimation of duration follows Stevens' psychophysical power law and to measure the exponent B, which describes the relationship between actual and estimated duration. Eisler (1976) examined 111 duration estimation studies spanning 100 years, in which actual duration ranged from .005 to 4800 seconds. Approximately 90 percent of the studies used actual durations of less than one minute. Exponents from each study were compiled and found on average to approximate .9. Thus, duration estimates, when plotted against actual duration, were best fit by a power function with a slope less than 1.0 and an intercept greater than 0. Similar results have been reported in more recent studies (e.g., Kane & Lown, 1986; Kowal, 1987). Two conclusions can be drawn from these results: (a), that duration estimation is not veridical, with estimation error being a function of actual duration (over- and under-estimation of short and long intervals respectively), and, (b), that in general very brief actual durations have been used. The last point is vividly illustrated in Eisler's review, where only a handful of studies used durations longer than one minute.

Arguably, many of the duration estimates that individuals routinely make relate to much longer intervals of time than a few minutes. This raises the question of whether the exponent value typically found with a relatively short actual duration range applies in situations in which duration is typically estimated. Some evidence that the same systematic estimation errors occur when events are dated has been found (e.g., Ferguson & Martin, 1983) and this is discussed in Section 1.3.1.

1.1.2 Stimulus Context

The learning situation or presentation of the stimulus to be remembered or estimated in the traditional type of experiment further reduces the possibility of elaboration at encoding and reconstruction at recall. As noted by Anderson (1980), the context in which an event occurs can provide useful information to aid reconstruction at the time of recall. A laboratory setting hardly mimics the complex environment in which events are usually

experienced. Learning or information encoding is generally incidental in real life, as opposed to the 'learning' to a set criterion employed in many traditional memory experiments.

A questionable aspect of such experiments concerns the effect of attention. Does being directed to observe something, as opposed to simply experiencing it, influence the way the memory system works? In relation to duration estimation there is ample evidence that knowing that a duration estimate of an interval is required (prospective paradigm) and being asked for an estimate after stimulus interval presentation (retrospective paradigm) produce markedly different results. Using the retrospective paradigm, duration estimates have been found to increase with the amount of information processed during the interval (Ornstein, 1969; G. Underwood & Swain, 1973) and as the amount remembered about events within the stimulus interval increases (Block, 1974; Ornstein, 1969). On the other hand, studies using the prospective paradigm have reported decreases in estimated duration as information processing during the stimulus interval increases (e.g., Burnside, 1971; Devane, 1974; Essman, 1958; Hicks & Brundige, 1974; Vroon, 1970; Warm & McCray, 1969). Furthermore, when the prospective and retrospective paradigms have been specifically compared, significantly different duration estimates have been obtained (Hicks, Miller & Kinsbourne, 1976). It is probably fair to assume that in the prospective paradigm a subject would be actively attending to duration. Thus the major difference between the prospective and retrospective experimental set-ups is one of attention during the stimulus interval's presentation.

Prospective duration estimates appear to be the more artificial. Generally, duration information is recalled retrospectively, often long after the event's occurrence. There are, of course, situations where one knows before an event that duration information is required, such as for a race or the time to reach a destination. However, in these situations duration information is not normally estimated but accurately timed using a stop-watch or wrist-watch. In addition it would be advantageous from the point of view of ecological validity for the estimator to experience the intervals to be estimated as they occurred in the course of everyday life, rather than under controlled laboratory conditions.

1.1.3 Retention Interval

Retention interval, the time between encoding and retrieval, is typically very short in both Ebbinghaus type memory experiments and duration estimation experiments (some notable exceptions in the memory field are Cofer, 1943; Smith, 1951; Titchener, 1923; Wicklegren, 1972; Worcester, 1957). In relation to memory research, Bahrick, Bahrick and Wittlinger (1975) proposed several reasons for this:

> "Investigators are reluctant to wait many years for answers to their questions . . . the same subjects are frequently no longer available for testing years after the original learning experience . . . methodological and conceptual changes diminish the relevance of results from an inquiry designed to answer questions posed many years earlier." (p. 55)

Another reason is to avoid the confounding effect of overt rehearsal and other events which might occur during the retention interval on retrieval performance.

Retention interval effects on duration estimation have been reported and are often referred to as time-order error (e.g., Allan, 1977; Hellstrom, 1977; Woodworth & Schlasberg, 1954). Typically, when two intervals of equal duration are presented to a subject in succession and an estimate of both intervals' duration is obtained, the first interval presented is estimated to be shorter than the second. The phenomenon is adequately accounted for by Ornstein's (1969) 'storage size' model of duration estimation which suggests that some of the information stored during the presentation of the first interval 'decays' over time and thus the interval is estimated as shorter than the second interval presented (see Allan, 1977, and Hellstrom, 1977 for other explanations).

The retention interval involved in studies of time-order error is, however, typically very brief; i.e. the two intervals to be estimated are presented in quick succession. The duration of an event is often recalled long after its occurrence, thus retention interval is often substantially longer than that used in time-order error studies. Furthermore, studies such as Loftus et al. (1987) and Marshall (1966), which required subjects to estimate the duration of a single interval, 48 hours and one week respectively after its presentation,

do not provide much relevant data on the effect of retention interval on duration estimation. A valid test of retention interval effects requires the estimation of a number of intervals (preferably of equal duration) experienced at various times in the past.

1.1.4 Dependent Measure

The dependent variable in duration research, the duration estimate, is generally analysed in terms of accuracy or, more specifically, the nature (under- or over-estimation) of the estimation error. However, the methods used to obtain duration estimates vary between studies and create results that are neither comparable nor homogeneous (Carlson & Feinberg, 1970; Clausen, 1950; Fraisse, 1984; Hicks et al., 1976; Hornstein & Rotter, 1969; McConchie & Rutschmann, 1971).

One of three methods of obtaining a duration estimate is usually adopted: (a) verbal estimation of the duration of an experienced interval, (b) production, where a verbalized interval is produced physically (e.g., 'Press this switch for 48 seconds'), and (c) reproduction, where an experienced interval is reproduced physically. Other less usual methods include comparison (Clausen, 1950), where two intervals are experienced and are judged relative to each other (also see McGrath & O'Hanlon, 1967), and the use of a time-line to indicate subjective duration (e.g., Ornstein, 1969). In the latter method the subject marks off a distance on the line which represents the duration of the experienced interval.

Studies comparing verbal estimation, production and reproduction have found significant between-method differences in terms of estimation accuracy (Clausen, 1950; McConchie & Rutschmann, 1971), the nature of the estimation error (Hornstein & Rotter, 1969) and intra- and inter-subject variability (McConchie & Rutschmann, 1971) (also see Fraisse, Bonnett, Gelly & Michaut, 1962; Hawkes, Bailey & Warm, 1961; Kruup, 1961; Ochberg, Pollack & Meyer, 1965; Treisman, 1963). The extent of the method effect is vividly illustrated in relation to the nature of estimation error. Studies have consistently found that duration is underestimated using the method of production (e.g., Clausen, 1950; Postman, 1944) and overestimated when a verbal estimate is given (e.g., Eson & Kafka, 1952; Hornstein & Rotter, 1969). Although the variation in results could be partially an artifact of

> " . . . subject variables, stimulus variables (modality, intensity, filled versus empty, etc.), response variables (reproduction and production: switch pressed for duration of estimate versus discrete presses at onset and termination of estimate versus single press for termination of estimate), standards and distribution of standards, grouping, order and sequence of methods within and between sessions, etc" (McConchie & Rutschmann, 1971, p. 323),

the number of studies which have found method differences suggests that there is an effect of method on duration estimation. Indeed, contradictory results within a number of specific research areas have been attributed to between-study method differences; for example, sense modality differences (e.g., Brown & Hitchock, 1965) and stimulus interval effects (e.g., Kowal, 1987).

The solution to the dependent variable dilemma appears to be simple. Duration is routinely reported verbally in terms of natural language time measuring words (e.g., hours, days, weeks, etc.), therefore, in order to study the process of duration estimation the method of verbal estimation should be used. The literature on the development of the time concept - duration being one aspect of this concept - supports the argument that verbal estimates are the most valid measure of duration estimation. As noted by Oakden and Sturt (1922) the development of a sense of time

> " . . . gives us the power to think in dates, to make and keep appointments, and to form plans involving temporal factors. It is obvious that in making such plans adults, at least, think directly in conventional units of time, e.g., minutes and seconds, and not in subjective sensations of duration." (p. 310)

Furthermore, routinely adopting verbal estimates as the dependent variable measure would not only increase ecological validity, but would also allow the results of studies to be more readily compared.

1.1.5 Ecologically Validity and Duration Estimation Research

The result of many memory researchers' acceptance of the Ebbinghaus approach is the fact " . . . that we have almost no systematic knowledge about

memory as it occurs in the course of ordinary life" (Neisser, 1976, p. 141). It is this author's belief that the same argument applies to duration estimation research, and for similar reasons. Furthermore, statements made in relation to the limitations of the available experimental data on memory, and suggestions that theorizing is premature, and that contemporary theories of memory simply attempt to explain highly artificial phenomena (e.g., Bruce, 1985a; Hirst & Levine, 1985; Neisser, 1985) are equally applicable to duration estimation research.

Why has this situation occurred? Perhaps, as Neisser (1985) noted in relation to memory research, it is " . . . far easier to stay in the laboratory where experiments can be explicitly designed to test the implications of the latest hypothesis" (p. 273), implying it is not easy to conduct ecologically valid research. Indeed, the difficulties associated with obtaining suitable information on experienced events and establishing its authenticity has undoubtedly contributed to the lack of ecologically valid memory research (Brewer, 1986; Robinson, 1976). This problem is perhaps even more salient in terms of duration research, but it can be overcome, as I hope to demonstrate in the studies presented in this thesis. There is a current trend developing within the memory research field toward the acceptance of alternative methodologies and more ecologically valid research. It is perhaps time for a similar trend to develop within the field of duration estimation research. What is required is a philosophical commitment on the part of researchers to try and understand duration estimation in the context in which it typically occurs.

Rather harsh criticisms of laboratory methods have been made in the preceding sections. However, some of the criticisms may not be justified if the results of more ecologically valid research are found to agree with laboratory research results. Indeed, although not specifically designed to investigate retrospective duration estimation, there are already a few studies which have reported duration estimation data relating to everyday life events. Loftus et al. (1987) note a study conducted by Schneider, Griffith, Sumi and Burcart (1978) in which crime victims estimated the time it took for the police to arrive at the crime scene. Estimates were matched with official police records; generally the estimates made by the victims were longer than those recorded. No data on the actual durations involved or the time between the incidents and when the estimates were made were reported. Baddeley, Lewis and Nimmo-Smith

(1978) asked members of an experimental psychology research panel to recall the duration of previous visits to the laboratory. Again no data on actual duration or retention interval was reported, the only data given showing that the estimates were not significantly different from the actual durations.

A few studies on child-bearing and child-rearing have also reported duration estimation data. Douglas and Blomfield (1956) used hospital records to assess the accuracy of mothers' recall of their child's hospitalization duration. A correlation of .94 was found between actual and estimated duration, yet they were found to be significantly different. The overall tendency was towards overestimation of hospitalization duration, a tendency that increased as the retention interval increased and the actual hospitalization duration decreased. Mednick and Shaffer (1963) also found a tendency towards overestimation when 14 mothers were asked to estimate how long they had breast-fed one of their children. Pediatricians' records were used to check the estimates. No data was reported on actual duration or retention interval. Pyles, Stolz and MacFarlane (1935) used archival records obtained from hospitals, physicians and public health nurses to assess the accuracy of mothers' estimates of gestation period and duration of labour. Mothers' estimates were obtained approximately 21 months after the events. A correlation of .61 was obtained between estimates of duration of labour and recorded duration. Overall the 158 mothers sampled tended to under-estimate the actual duration by approximately 30 minutes. The mean actual duration of the event was reported as 8 hours and 57 minutes. Duration of gestation was, on the other hand, generally estimated accurately with no discernible error tendency. No data on actual duration was reported for this event, although, one might assume that it would have been around 9 months, as the respondents probably did.

The above studies suggest that duration estimates under ecologically valid conditions are not veridical, a finding which is consistent with the laboratory study results reported earlier. The tendency towards event duration overestimation reported by Schneider et al., (1978), Douglas and Blomfield (1956) and Mednick and Shaffer (1963) is, however, difficult to interpret as it can not be established on the basis of these results, what factor, or factors, produced the tendency. It is unclear if it was the events themselves (a possibility considering Pyles et al.'s 1935 results), the duration of the events, or perhaps retention interval which produced the overestimation tendency.

1.1.6 Models of Duration Estimation

The general nature of duration estimation research, described in the preceding sections, suggest: (a) that because of between-study procedural differences, it is difficult to make conclusive statements on the factors that mediate duration estimation, and (b) that the experimental methodology typically used lacks ecological validity and it is doubtful whether the results of much of the existing research apply to everyday life situations (such as those described in Section 1.0) in which duration information is routinely recalled. Despite this problem, it is still necessary to consider the results of this type of duration estimation research, since models proposed to account for duration estimation are typically based on it.

Both biological and cognitive models have been proposed to account for the process of duration estimation. Contemporary research, however, tends to favour cognitive explanations, which more adequately accommodate the majority of research results (Poynter & Homa, 1983). Metabolic functioning may perhaps be better considered as a factor which indirectly mediates duration estimation rather than directly forming the basis of such estimates. That is, although the experimental manipulation of factors such as body temperature (e.g., Baddeley, 1966; Fox, Bradbury, Hampton & Legg, 1967; Hoagland, 1933; Pfaff, 1968) has been found to affect duration estimation, it should not be concluded that physiological processes are directly responsible for the nature of duration estimates. Physiological reactions may simply appear to relate to duration estimation because they vary with external or internal stimulation. This stimulation may well also affect other processes, including cognitive activity. Furthermore, a biological clock explanation of duration estimation (e.g., Francois, 1927; Hoagland, 1933) cannot account for how duration can be estimated long after an interval was experienced.

Four cognitive models of duration estimation have been put forward. Guyau (1890) proposed possibly the first formal duration estimation model based on human information processing (Ornstein, 1969), although the relationship between cognitive activity and duration estimation had been noted much earlier, as illustrated by Aristotle's comment that "only those animals which perceive time remember, and the organ whereby they perceive time is also that whereby they remember" (cited in Block, 1974, p. 153). Guyau suggested that the experience of duration is related to the stimulus interval in

terms of the intensity and number of elements within the interval, and the differences between these elements. The attentional value of the interval's elements, as well as their associative characteristics, was also considered important. Obviously, Guyau's model is not very specific. However, it does, at least indirectly, make reference to all of the information processing activities which have since been specifically incorporated in models of duration estimation; these models have been referred to as the attentional, informational, contextual-change, and event-memory hypotheses (Block & Reed, 1978).

Common to each of the above models is an implied positive relationship between an increase in cognitive activity and duration estimation. The attentional hypothesis (see Underwood, 1975; Underwood & Swain, 1973) emphasizes characteristics of the information-processing task performed during the interval to be estimated. Both high attentional demands resulting from the interval's elements and from attention to the passage of time during an empty interval are suggested to lengthen an estimate of an interval's duration. The informational hypothesis, sometimes referred to as the 'processing effort model' (Poynter & Homa, 1983), also emphasizes the extent of processing, or processing time required during the interval to be estimated. For example, Vroon (1970) proposed that duration estimates directly relate to the amount of information transmitted during an interval. A number of studies have found processing effort effects (e.g., Block, 1974; Burnside, 1971; Hicks, et al., 1976; Vroon, 1970), but the relationship between estimated duration and processing activity has been shown to vary with the interval's actual duration. That is, with short durations (less than 10 seconds), the relationship is positive, while longer durations tend to produce the inverse relationship.

Obviously, both the 'attentional' and 'processing effort' models focus on the information processing activities that occur during the experience of an interval or event. Therefore, they do not explicitly accord memory a role in duration estimation. That is, they do not consider the product of an interval, in terms of what one remembers of it, forms the basis of its estimated duration. The contextual-change and event-memory hypotheses, on the other hand, do focus on memory retrieval processes. These models are therefore perhaps more adequate as explanations of duration estimation, as such estimates are not only made immediately after the experience of an interval but also after

considerable delays. Obviously, to estimate the duration of an interval or event experienced 6 months ago one would, generally, have to remember the event, and it seems reasonable to assume one's memory of the event would not be of its attentional demands or the information processing effort involved at the time.

The contextual-change hypothesis (Block & Reed, 1978) was first proposed by Fraisse (1963) who suggested duration estimation was mediated by "the number of changes observed" (p. 219) during an interval. Although this model emphasizes one's memory of an interval, it postulates that it is not the actual extent of the remembered interval's events that is important "but rather memory for the overall change in cognitive context during an interval" (Block & Reed, 1978, p. 664). This is based on the assumption that different tasks require somewhat different cognitive processes. Block and Reed (1978) found support for this model in experiments where intervals containing different kinds of 'levels of processing' tasks were estimated to be longer than equivalent intervals containing only one type of task, and where level-of-processing was found to affect event memory but not duration estimation.

Of the event-memory hypotheses, Ornstein's (1969) 'storage size' hypothesis is undoubtedly the most widely recognized (Fraisse, 1984). Furthermore, Fraisse considers that it is the most dominant in terms of retrospective duration estimation. Ornstein was, however, not the first to formalize the relationship between remembered event information and duration estimation. Frankenhaeuser (1959) conducted a series of experiments from which he concluded that the amount of 'mental content' from an interval positively influences one's estimate of its duration. Ornstein's model is, however, more complex than Frankenhaeuser's. Ornstein suggests that duration estimation is proportional to the size of the storage space of the "information remaining in storage" from the interval being estimated (Ornstein, 1969, p. 104). Thus, rather than an estimate being proportional to the information input during an interval, it is the information remaining in storage that is important.

Ornstein's (1969) emphasis on the information remaining in storage allowed him to accommodate the duration estimation phenomena of 'time-order error'. As already noted, such errors are found when the duration of two intervals of equal duration are estimated; the first typically being

underestimated relative to the second. Ornstein accounts for this by assuming that

> "When some period elapses before an interval is to be judged . . . some items should drop out of storage and the experience of duration of that interval shortens." (p. 48)

Thus the storage size of the first interval is smaller than the second at the time of estimation. Ornstein's model is also able to account for many other duration estimation findings, such as the 'filled duration illusion', and the typical finding that estimated duration is proportional to the number and complexity of elements within the interval to be estimated.

Considering all the models of duration estimation, Ornstein's is the most applicable to the wide range of situations in which duration estimates are normally made. In contrast to the other models it accounts for how an event's duration can be estimated long after its occurrence. In line with these comments, Ornstein's (1969) 'storage size' model of duration estimation is assessed in relation to public event duration estimation in Experiments 1 through 4, and in relation to personal event duration estimation in Experiment 6, Part b.

1.2 Memory: Temporal Components

Ornstein's (1969) model suggests that the memory system plays an important part in duration estimation. Temporal characteristics, such as sequence and duration, are also important variables when recalling a past experience or event. The importance of temporal information within the memory system is primarily associated with autobiographical memory, that is, memories of events personally experienced by the subject (Brewer, 1986; Fitzgerald, 1986; McCormack, 1979; Neisser, 1986; Robinson, 1976; Schactel, 1947) and where knowledge of events in the lives of others, such as 'public figures' or friends, obtained via the media or inter-personal communication are explicitly excluded (Loftus & Fathi, 1985; Whitten & Leonard, 1981). Such personal memories are explicitly required when people produce anamnestic data during psychological and medical treatment (Moss & Goldstein, 1979) and when witnesses testify about past events (Loftus, 1979).

Temporal components of memory have been explicitly incorporated in some accounts of memory. Temporal information, for example, is at the basis of the episodic/semantic memory distinction proposed by Tulving (1972). Tulving suggested that episodic memory stores temporally dated episodes or events and the temporal-spatial relations among them. For example, "The car came out of the garage last Friday, having been repaired after breaking down on the preceding Wednesday". Obviously the temporal components of sequence and duration are important for the meaning of this memory. Semantic memory, on the other hand, stores the generalized knowledge a person has about the world; knowledge of objects, concepts, rules and meaning which are necessary for the use of language. Semantic memory then is not essentially associated with a particular point in time. A similar distinction to Tulving's episodic/semantic one, was made by Schactel (1947), who contrasted autobiographical and utilitarian memory.

Tulving's (1972) attempt at classifying the phenomena and processes of memory sparked off considerable controversy (e.g., Anderson & Ross, 1980; McKoon, Ratcliff & Dell, 1986; Ratcliff & McKoon, 1986; Tulving, 1985, 1986; Warrington, 1986). The idea that there exists in fact two structurally and functionally different memory systems, as opposed, say, to the distinction having heuristic value, has been most vigorously questioned (Tulving, 1986). Accepting the episodic/semantic distinction implies the need for a dual-store model of long-term memory, whereas most currently favoured memory models postulate a 'single-store' (McKoon et al., 1986). The semantic/episodic debate focuses on the encoding and storage aspects of the memory system. In relation to the present discussion of the temporal characteristics of memory, there is general agreement that such information (i.e., when an event took place) is a necessary aspect of episodic memory recall.

1.3 Dating Events

As already noted, dating a past event can be carried out when answering a specific type of duration question (e.g., "How long is it since you left Mt. Cook?"). A large number of studies have been conducted on event dating, and can be divided into three categories on the basis of the methodology used; (a) traditional Ebbinghaus type experiments where subjects typically judge the serial position of words or the relative recency of pairs of words from sequentially presented lists, (b) the dating of significant public events, and (c)

the dating of autobiographical events. Research has also been conducted on the response bias inherent in survey data, and some of this research is relevant to a discussion of event dating. In the following sections, research on event dating is reviewed in order to elaborate current positions on the types of dating errors that are typically made, the factors that influence these errors, and finally, the models proposed to explain how events are dated.

It should be noted at this point that a number of studies have required subjects to date recalled autobiographical memories, but have obtained no information on the accuracy of, or processes involved in, event dating. These studies have typically used single-word or phrase prompts to facilitate the recall of specific autobiographical experiences. The dates assigned to the recalled memories (which the experimenter has no way of verifying) have been used to examine the distribution of the recalled memories across the life-span (e.g., Crovitz & Schiffman, 1974; Fitzgerald, 1981; Fitzgerald & Lawrence, 1984; Franklin & Holding, 1977; Holding, Noonan, Pfau & Holding, 1986; Pillemer, Goldsmith, Panter & White, 1988; Pillemer, Rhinehart & White, 1986; Uhlenhuth, Haberman, Balter & Lipman, 1977), the organization and search processes involved in autobiographical memory (non-temporal components) (e.g., Reiser, Black & Abelson, 1985; Reiser et al., 1986; Riegel, 1973; Robinson, 1980), and the nature of autobiographical memory recall in special populations, such as amnesic, Korsakoff's and ECT patients (e.g., Sagar, Cohen, Corkin & Growdon, 1985; Zola-Morgan, Cohen & Squire, 1983). Further details on these studies and the methods involved are reported in Chapter 3.

1.3.1 Date Responses: Accuracy and Error

Perhaps the best place to begin an examination of event dating is to consider the nature of the responses that are typically made, and, in particular, the accuracy of event dating. Proposed models of event dating must be able to account for the systematic errors that occur, and it is, therefore, logical to consider them in light of the available data on date response characteristics.

In order to examine the accuracy of event dating, it is first necessary to establish precisely when the events to be dated actually did occur. Usually this presents little problem when the events are public (e.g., the assassination of J. F. Kennedy); the precise dates of autobiographical events, on the other hand, are

rather more difficult to verify. Bruce and Van Pelt (1989), Linton (1975), Wagenaar (1986), and White (1982) achieved this by recording daily a sample of their activities and then later dating these events. Self-recording of daily activities and subsequent dating of the events was also employed by Barclay and Wellman (1986), Thompson (1982, 1985a, 1985b), and Thompson, Showronski and Lee (1988). However, rather than recording their own daily activities, the latter authors instructed a sample of subjects as to what to record and examined these subjects ability to subsequently date the recorded events. Essentially these experimental techniques fall within the category of longitudinal research. The delay inherent in this type of research is avoided in studies of event dating by using archival records to determine the subject's involvement in and the precise actual date of the events to be dated. A range of different types of events have been used, for example, a psychology course examination (Loftus & Fathi, 1985), attendance at an experimental psychology laboratory (Baddeley et al., 1978). A similar cross-sectional research approach has been employed in studies which have examined subjects' ability to date significant public events, such as 'Lord Mountbatten's assassination' (e.g., Brown, Rips & Shevell, 1985; Brown, Shevell & Rips, 1986; Ferguson & Martin, 1983; Friedman & Wilkins, 1985; Kemp, 1987, 1988; Lieury, Aiello, Lepreux & Mellet, 1980; Lieury, Caplain, Jacquet & Jolivet, 1979; Perlmutter, Metzger, Miller & Nezworski 1980; Underwood, 1977). In all of the above studies it was possible to compare the date a subject assigned to an event with its actual date of occurrence.

The accuracy of the date assigned to an event by the subject is generally measured by its deviation from the event's actual date of occurrence. Two different measures of dating error are often used: signed error, in which the direction of the deviation is included, and absolute error, where the sign of the deviation is ignored. Signed errors measure whether an event was dated more recently or more remotely than it actually occurred. Such errors are often referred to as under- and over-estimation of actual event age, respectively (e.g., Baddeley et al., 1978; Ferguson & Martin, 1983; Lieury et al., 1979; Livson & McNiell. 1962). They have also been referred to, respectively, as forward- and backward- telescoping (e.g., Loftus & Marburger, 1983; Thompson et al., 1988). However, the use of the latter terms to describe systematic dating errors originated in research on the error in responses to autobiographical questions which require activity frequency estimates (see Section 1.3.2).

Assigned and actual event dates are consistently reported to be positively correlated. Baddeley et al. (1978) obtained a correlation coefficient of .57, Brown et al. (1985) .88, Brown et al. (1986) .83, Bruce and Van Pelt (1989) .77, Ferguson & Martin. (1983) .66, Lieury et al. (1979) .72, Livson & McNiell. (1962) .75, Underwood (1977) .96 and White (1982) .26, .40, and .26 over three attempts to recall event date. These correlations suggest that the subjects were reasonably good at determining the ordinal temporal relations among events. However, the mean absolute dating error reported in some studies (e.g., 11 months, Brown et al., 1985; 15 months, Underwood, 1977) suggests that this is not because the subjects knew the actual date of occurrence very often. Substantially smaller mean absolute dating errors, ranging from .93 to 2 days, were reported by Loftus & Marburger (1983). However, these means were obtained from the dating of only three or four events (e.g., examination dates), and dating errors greater than 7 days were counted as 7 days.

The accuracy of event dating was also investigated by Rubin (1982), Experiment 5, using a rather ingenious procedure. A sample of diary keepers who agreed to participate in the research was obtained from an undergraduate psychology course. These subjects were requested to recall and date 100 autobiographical events. Recall was without prompts. The subjects were then provided with their 100 event descriptions and asked to attempt to re-date them using their diary records. A total of 513 events were re-dated in this manner by the nine subjects who participated in the study. A between-subject median absolute dating error range of 0 to 37 days, and a group median of 3 days was reported. Twenty-seven percent of the events had been exactly dated by the subjects, 34 percent were within one day, 59 percent within seven days, 74 percent within a month, 93 percent within a year and 97 percent within two years.

Investigations of the reliability of event dating, although few in number, also provide valuable data on the accuracy of event dating. Several studies of dating reliability have employed Galton's (1879) word-association technique which requires subjects to recall a specific autobiographical experience cued by a prompt word, such as 'street' or 'church' (e.g., McCormack, 1979; Robinson, 1976, 1986). Subjects were required to date the recalled memories and then, after a delay, were again presented with their descriptions of the recall memories and asked to re-date them. The actual procedures varied slightly between the studies; for example, subjects in McCormack's study could date

recalled events by providing calendar year, the duration since the event or their age when the event occurred, while Robinson (1976, 1986) requested year and month as a minimum. Elapsed time between dating and re-dating also varied slightly between the studies; Robinson used an interval of two weeks in 1986 and 1 week in 1976, the latter time being similar to that used by McCormack (1979). All three studies found reasonably high product-moment correlation coefficients between the two sets of assigned dates, .98 (McCormack, 1979), .94, (Robinson, 1976), and .66 and .84 (Robinson, 1986). The correlations obtained by Robinson (1986) were obviously lower but this may be attributable to the introduction of a slightly different procedure in the re-dating phase of the experiment. The primary objective of Robinson's study was to examine strategies adopted when dating events.

The above results suggest that the date assigned to an event may be quite reliable; that is, subjects are fairly consistent in their recall of when they think the event occurred. However, the obtained correlations are not perfect. Robinson (1976) reported that the majority of the difference between the two sets of dates was in the year component. That is, subjects changed their mind about the year an event had occurred in more frequently than for the month or day of the month. A similar result was reported by Rubin (1982) when assigned date was compared with the diary record of the event.

Retention interval, the time between the occurrence of an event and an individual's assignment of a date to it, is perhaps the most important factor in determining the extent and nature of event dating error. Researchers have consistently reported that absolute dating error increases as retention interval increases (e.g., Baddeley et al., 1978; Barclay & Wellman, 1986; Friedman & Wilkins, 1985; Lieury et al., 1979; Linton, 1975; Perlmutter et al., 1980; Thompson, 1982, 1985a, 1985b; Thompson et al., 1988). However, no retention interval effect is generally found when subjects date very recent events. Thompson et al. (1988) found very accurate event dating within two weeks of an event's occurrence, as did Linton (1975).

The extent of the retention interval effect on absolute dating error has been investigated in some studies. Barclay and Wellman (1986) reported that absolute dating error increased from 9 to 22 days as retention interval increased from one month to a maximum of 12 months, Baddeley et al. (1978), an increase of 19 days for every 100 days of retention interval, and Thompson

(1982, 1985a), one day for every week of retention interval, while Linton (1975) reported an average absolute error of 12 days over a 12 month retention interval.

Retention interval also has an effect on the sign of the event dating error, that is, whether the error is an under- or over-estimation of an event's actual age. Brown et al. (1985) reported a product-moment correlation between signed error and actual date of -.74, and Baddeley et al. (1978) -.33. These correlations suggest a tendency toward underestimation of event age as retention interval increases, a result which is generally found when the dating error of a number of event of different ages is averaged (Kemp, 1988). Thompson et al. (1988) reported that this underestimation tendency was significant when the retention interval reached three months. While the general tendency is for event age underestimation to increase as retention interval increases there is some evidence that for recent events the age of the event is overestimated (e.g., Ferguson & Martin, 1983; Kemp, 1988; Lieury et al., 1979, 1980; Loftus & Marburger, 1983). Not all event dating studies have, however, found an overall dating bias, Wagenaar (1986), White (1982) and Rubin (1982) found dating error to be evenly distributed between under- and over-estimation.

Ferguson and Martin (1983) had subjects indicate on time-lines the date when they considered 12 significant public events (e.g., the visit of Pope John Paul II to the U.S.A) had occurred. Retention interval was defined as the interval between the occurrence of the event and the date of testing, and ranged from 3 to 55 months. The obtained data was found to be fitted by a straight line with a slope of .66 and an intercept of .45. Thus the age of the recent events were typically overestimated and those of the remote events underestimated. Ferguson and Martin interpreted retention interval as a duration and the assigned date as a duration estimate. Thus their results can be viewed as showing similar error tendencies to those typically found in duration estimation research where intervals of short and long actual duration are over- and under-estimated, respectively (refer Section 1.1.1).

The effect of retention interval on dating error may, however, be different for the various components of a recalled date. A date can be divided into three components; year, month and day of the month. Friedman & Wilkins (1985) examined the relationship between retention interval and

absolute dating error for each of these components separately. Year and month analysis produced results consistent with those reported above. However, accuracy in determining the day of the month component was not related to retention interval. The hour of the day that the event occurred was also requested and recall was found to be independent of retention interval. A somewhat similar result was obtained by White (1982), who suggested that time of day might be reconstructed rather than recalled: "For instance, if given the description 'Lunch on terrace', it is not hard to guess it occurred somewhere around midday" (p. 179). Evidence of this type of reconstruction was found by Friedman & Wilkins, Experiment 2, where subjects indicated, in fictitious stories, event times (time of day) that were closer to actual event times than expected by chance.

Overall, the results of studies on event dating accuracy are reasonably consistent. Some of the apparent between-study dating accuracy differences may be attributable to the use of slightly different dependent measures; for example, Brown et al. (1985), Brown et al. (1986) and Underwood (1977) required subjects to recall year and month of occurrence only, while Baddeley et al. (1978) also required subjects to indicate the day of the month by marking a point on a 10 cm line. In general, the preceding results suggest that: (a) individuals can assign a date to an event with some measure of accuracy, (b) that they are reasonably consistent in their determination of when events occurred, (c) that retention interval has a significant effect on dating accuracy, and (d) that retention interval also has an effect on the sign of dating error.

1.3.2 Survey Data: Response Errors

Retrospective surveys are frequently used as a basis for policy decisions (Potter, 1977), as well as providing much of society's knowledge about such issues as the prevalence of crime, sickness and diseases, and consumer expenditure. The accuracy of survey data is, therefore, of vital importance. Systematic dating errors have been observed in surveys which have required specific events to be recalled and dated (see Bradburn, Rips and Shevell (1987) for a recent review). The most extensive examination of dating error in relation to this type of survey question has been in the area of birth-history or fertility analysis (e.g., Blacker & Brass, 1979; Potter, 1977; Som, 1973). Where it has been possible to compare survey responses with official records (registrars of births), large errors have been found.

Blacker and Brass (1979) reported a study by Gibril (1976) in which survey responses were compared with Medical Research Council records. The sample population lived in four villages in Gambia, Africa; and births and deaths were closely monitored over a prolonged period. Of interest to the present discussion are the results of the comparison between assigned date of a child's birth and the actual date. The comparison revealed systematic dating errors with births that occurred in the preceding three years being dated further back in time and births that occurred 10 to 15 years before being dated more recently than their actual date. Thus both over- and under-estimation of event age were found. This is a particularly interesting finding, since normally one would expect a child's birth date to be recalled rather accurately because of the yearly celebration of the date, for example the birthday party.

The age of event overestimation trend observed in Gibril's (1976) study is particularly worrying for investigators of fertility rates. Such errors could easily result in researchers overestimating the decline in birth rate or reporting a decline which is not actually occurring (Potter, 1977). Overestimation errors have also been observed in fertility surveys in El Salvador and Bangladesh (Potter, 1977); but in general, both under- and over-estimation errors are likely to occur. Som (1973) noted that such errors (border bias) were evident in demographic survey data obtained in Guinea and the Ivory Coast. He also noted that the combination of these errors was probably responsible for a general tendency in retrospective field surveys to over-estimate births and deaths within a specified reference period.

Evidence of both under- and over-estimation errors was also reported by Douglas & Blomfield (1956). They asked mothers to recall the age of one of their children at the time the child had been hospitalized. Hospital admission records were used to check hospitalization dates. Comparing the mothers' responses and the hospital records indicated that when retention interval was less than two years there was a slight, but not significant, underestimation of the admission age. With longer retention intervals age at admission was found to be significantly overestimated. This result is interesting, as it indicates that recalling information other than a date can be subject to the same systematic errors mentioned above.

Response errors similar to those mentioned above have also been found for survey questions which require activity frequency estimates such as;

"During the past 12 months, about how many visits did you make to a dentist?" (National Centre for Health Statistics, cited in Bradburn et al., 1987), and which are attributed to event dating errors. In the above question, the required quantitative response is presumably generated by recalling specific autobiographical events (visits to a dentist), dating these events, and then determining whether each particular recalled event occurred within the reference period (e.g., 'the past 12 months') defined in the question.

Research on activity frequency estimates generally uses the terms forward- and backward-telescoping to describe specific types of error (e.g., Bradburn et al., 1987; Bushery, 1981; Gray, 1955; Neter & Waksberg, 1964; Penick & Owens, 1976; Quackenbush & Shaffer, 1960; Schneider & Sumi, 1981; Sudman & Bradburn, 1973, 1974, 1982; Woltman, Bushery & Carstensen, 1975). The term forward-telescoping, also called 'end-period effect' (Kemsley, 1979), and 'telescopic effect' (Som, 1973), describes a tendency to overestimate activity frequency because events that occurred outside the reference (more than 12 months ago) are recalled as occurring within it. Thus the age of events is underestimated. Backward-telescoping, also called the 'receding effect' (Som, 1973), occurs if the reference period defined in the question is not bound at one end by the interview. That is, if in the above example, the question was in the form "How many visits did you make last year to a dentist?" A backward-telescoping error results if an incorrect assigned date moves an event back into the question's reference period; the age of the event is overestimated. In the above examples, 'external' telescoping effects are described (Woltman et al., 1975), with both types of telescoping errors producing event frequency overestimates.

Telescoping errors can also remove events from the reference period, resulting in event frequency underestimation, or change the distribution of events within a reference period. The latter effect is sometimes referred to as 'internal-telescoping' (Woltman et al., 1975). Generally, however, research has focused on external telescoping effects and attributed event frequency underestimation to omissions or forgetting. Collectively, forward- and backward-telescoping errors are referred to as 'border bias' (Sudman & Bradburn, 1974) or 'boundary effects' (Som, 1973).

Schneider and Sumi (1981) found mainly forward-telescoping errors in a survey of crime-victimization (also see Garofalo & Hindelang, 1977; Penick &

Owens, 1976), as did Neter and Waksberg (1964) in the reporting of household alterations and repairs. Forward-telescoping appears to be more frequent than backward (Schneider & Sumi, 1981; Sudman & Bradburn, 1974), and it poses a serious problem for survey researchers as it can not be controlled for as easily as backward-telescoping. The extent of the forward-telescoping error also appears to increase as the frequency of the event being investigated increases, possibly because the likelihood of confusion about dates increases (Sudman & Bradburn, 1974). The reference period defined in the question further influences the magnitude of the error. More actual forward-telescoping is likely as the reference period increases, but the actual size of the error increases as the size of the reference period decreases (Sudman & Bradburn, 1974). This is because the percentage of events erroneously included increases. Finally, the type of event or behaviour being investigated can influence the magnitude of the error. There are likely to be fewer omissions or event forgetting for salient events, and thus the compensating effect such omissions have on telescoping errors will be reduced (Neter & Waksberg, 1964). In general then the telescoping effect is a complex one and with forward-telescoping errors on the order of 20 percent not being uncommon - some studies have revealed errors as high as 60 percent (Schneider & Sumi, 1981) - it is a significant source of error in retrospective surveys.

Several attempts have been made to develop an exponential model which adequately describes the nature of telescoping and omissions , and that can be used to adjust survey data accordingly (e.g., Potter, 1977; Neter & Waksberg, 1964; Sudman & Bradburn, 1974). However, the research results indicating the complex nature of telescoping effects have frustrated these attempts at model building. In relation to estimates of crime rates, Schneider and Sumi (1981) note that

> " . . . the likelihood of developing a general model for correcting mnemonic biases is probably very low. This assessment follows from: (1) evidence indicating differential victimization survey recall across reported and unreported crime events; (2) the apparent dissimilarities of telescoping/forgetting patterns across samples and seasons, and (3) the lack of a stable comparison estimate of the 'true' distribution of incidents with which to calibrate a correction model." (p. 409-410)

These factors are also likely to be just as applicable to other types of events, indicated by Potter's (1977) concluding remark in his paper, in which an attempt was made to construct such a model to adjust birth-history data; " . . . the ultimate goal of arriving at a set of satisfactory 'correction factors' is, I think, out of reach" (p. 364).

Research on response bias in survey data appears to have found results which are consistent with those reported in studies of event dating. The finding that forward-telescoping errors are more common that backward-telescoping errors and that forward-telescoping errors increase as the retention interval increases can be accounted for by the tendency of subjects in event dating studies to generally underestimate the age of events and for this tendency to increase as retention interval increases.

1.3.3 Factors Effecting Date Responses

A number of studies have specifically investigated what factor or factors cause the systematic dating errors cited above. Brown et al. (1985) proposed an 'accessibility hypothesis' which states that the more a subject recalls of an event, the more recently it will be determined to have occurred. This hypothesis is based on two assumptions. First, as the time since an event's occurrence increases, less information about the event will be remembered, that is, there is decay of memory strength over time. Secondly, that subjects, when dating events, take into account the amount of event related information they can retrieve as one indication of the event's age.

In order to test their hypothesis, Brown et al. (1985) selected a sample of significant public events that had occurred during the life-time of the subjects. Subjects were presented with short descriptions of the events (e.g., United States signs the Panama Canal Treaty), and required to date each event, and to indicate on a 0 to 9 scale how much they remembered about each event. Date responses were in terms of year and month of the event's occurrence. Examination of the dates assigned to the high and low knowledge events indicated that the high-knowledge events were generally dated as having occurred more recently, a tendency towards underestimation of event age. Further support for the accessibility hypothesis was found when the date responses of subjects who rated their knowledge of an event before dating it were compared to those who dated the event first. Giving a knowledge rating

for an event was assumed to involve active memory searching for relevant information, thus making the event more accessible at the time of dating. As predicted, there was a general tendency for the group who rated before dating to assign more recent dates to events.

Similar event knowledge/date assignment results were obtained when event knowledge was accessed objectively using recall protocols (e.g., Brown et al., 1985, Experiment 3), and when the time taken to indicate if a specific event occurred before or after a presented date was examined (e.g., Brown et al., 1985, Experiment 4). In the latter experiment, comparison times of high-knowledge events were faster when they were compared to early dates, and comparison times of low-knowledge events were faster for later dates. This result is consistent with the observed tendency for high-knowledge events to be dated more recently, thus resulting in a quicker determination of the relationship of the event to a presented date (e.g., before or after) when the presented date is an early date.

Memory strength effects have also been found in studies of recency judgements of items such as words or nonsense syllables presented in list form under controlled laboratory conditions. One of two procedures is typically employed. In one procedure, each item is presented twice, separated by a specific number of intervening items, and subjects are required to state how far back in the series the first presentation occurred when the item is presented a second time (e.g., Hinrichs, 1970). Alternatively, subjects are presented with two items from a list presented earlier and must decide which item was presented more recently (e.g., Fozard, 1970; Morton, 1968; Wolff, 1966; Yntema & Trask, 1963). In the former paradigm, subjects make absolute recency judgements, in the latter they make relative judgements. The applicability of this type of research to the present discussion has been questioned by a number of authors (e.g., Brown et al., 1985; Loftus & Marburger, 1983) and detailed criticisms of this type of experimental procedure has been made in earlier sections of this thesis. Therefore, the applicability of the results of these studies should be not be taken for granted.

The general finding of these laboratory experiments is that the memory strength of an item is positively related to recency judgements. That is, items with stronger memory traces are judged to have been presented more recently. Item memory strength is not accessed directly but rather assumed on the basis

that memory strength is a decreasing exponential function of time elapsed since item presentation or the number of items presented between the first and second presentation of an item (Tzeng & Cotton, 1980). A more direct assessment of item memory strength was employed by Brelsford, Freund and Rundus (1967) who found accuracy of a recalled item to be positively related to recency judgements. In general then this type of research has produced results similar to those obtained by Brown et al. (1985).

Both studies using public events and those requiring recency judgements have reported memory strength effects on the determination of an event's date of occurrence. However, in both sets of studies the experimental procedures are atypical of the situations in which temporal information is routinely recalled. This is particularly true of recency judgement studies. Thompson et al. (1988) attempted to find a memory strength effect under more realistic conditions. Subjects were instructed to record in a diary one unique personally experienced event per day for three months. Recorded events were collected at the end of each week. One week after the completion of the recording phase, subjects were presented with their recorded event descriptions, and events determined not to be unique at this time were removed from the sample. The remaining events were then rated as to how well they were remembered on a 7-point scale. Only those events that were remembered were then dated using a calendar.

Examination of the dates assigned to these personally experienced events indicated that as retention interval increased, there was a tendency to date events more recently than their actual date of occurrence. However, no reliable difference in this tendency was found between well and poorly remembered events. Thus, no support for Brown et al.'s (1985) accessibility hypothesis was evident in the data. A similar result was also found by Thompson et al. (1988) when two other sets of data obtained using the same methods and procedures were examined. Thompson et al. also tested the accessibility hypothesis using a personally experienced/reported event dating comparison. Both types of events were obtained using the diary procedure outlined above. Personally experienced events, as used in the preceding experiment, were defined as "directly experienced or first-hand personal experiences", while reported events were defined as those "events that someone else has told you about" (Thompson et al., 1988, p. 465). Although a reliable date underestimation tendency, which increased with retention

interval for both types of event, was found; no reliable effect of either type of event or vividness of memory, indicated by obtained knowledge ratings, was found. It is probably fair to assume that there would be a memory strength difference between experienced and reported events, although Thompson et al. did not note any difference in the obtained memory ratings.

Kemp (1988) also investigated the effect of event knowledge, determined by ratings on a 9-point knowledge scale, on dating errors. One hundred public events were dated by the subjects, 50 being 'historical' events and 50 'recent' events. Both types of event were generally dated more recently than their actual date of occurrence. However, analysis of the dating errors of the poorly- and well-known events indicated no significant tendency towards event age underestimation as event knowledge increased. Indeed, for the historical events the opposite was found with the poorly remembered events being dated more recently than the well-known events. Event knowledge was, however, found to be positively related to dating accuracy for both the recent and historical events.

Some of Thompson's earlier work has also reported event memory effects on dating accuracy (e.g., Thompson, 1982; 1985a, 1985b). These studies employed the diary procedures described above. Dating accuracy was found to be positively related to memory ratings obtained at the time of dating and to perceived memorability noted at the time of event recording. Thompson (1982), however, noted that the event memory effect interacted with retention interval. That is, event memory only reliably affected dating accuracy for events occurring up to approximately 7 weeks before dating. Event memory effects were also used to explain the dating accuracy difference found between very pleasant and very unpleasant events (e.g., Thompson, 1985a). The former type of event was dated more accurately, but was also found to be rehearsed more frequently. Probably more frequently rehearsed events would be better remembered.

Friedman and Wilkins (1985) also suggested an event memory effect on dating accuracy. Their study was conducted in England, and three of the public events dated, relating to the British Royal Family, were found to be dated more accurately than the other events. The authors proposed that this was because of the greater importance of these events for their subjects, and hence they might be more memorable. A similar result was also reported by White

(1982), with his rated memory of an event being positively related to the accuracy of the date assigned to it.

It appears that event memory has an effect on dating accuracy, with this result being reported in studies which have used both personal and public events. The influence of memory of the event on the sign of dating errors is, however, unclear. While Kemp (1988) and Thompson et al. (1988) failed to find an effect, Brown et al. (1985) found memory strength effects consistent with those obtained in recency judgement studies. Wagenaar (1986) also found some evidence of memory strength effects on the sign of dating error. There is no doubt that systematic dating errors do occur, with a general tendency towards event age underestimation as retention interval increases. But whether this is due to memory strength effects or retention interval *per se* is unclear.

Two new and somewhat related models of event dating bias suggest that such errors are due to boundary effects (e.g., Huttenlocher, Hedges & Prohaska, 1988; Rubin & Baddeley, 1989). The boundary in an event dating experiment is the time within which the events must have occurred; for example, in Thompson et al., (1988) the boundary is created by the diary-keeping procedure. The subjects in this study would know that the events they were dating occurred within the time of their involvement in the study; the remotest and most recent boundary markers being the date when they started and stopped recording events respectively. The boundary model assumes that events will not be assigned dates outside these boundaries. Therefore, unless the subject is willing to provide a date which is outside a boundary, dating errors for the remotest and most recent events can only move the assigned date towards the mean date of the events being dated. Thus, the remotest and most recent events, if dated inaccurately are assigned dates that are too recent and too remote respectively.

Furthermore, the boundary model suggests that the overall tendency for events to be dated too recently can be explained by the effect of retention interval on absolute dating error. As retention interval increases, dating accuracy diminishes, therefore more remote, than recent, events are likely to be dated inaccurately. The signed error of remote events is positive because they are not assigned a date outside the remote boundary. Thus signed error,

when averaged over all the events, will be positive because the majority of the signed errors are positive.

1.3.4 Models of Event Dating

Models of how people answer 'when' questions vary not only in terms of the postulated processes involved, but also in the research that has been employed in their development. Broadly speaking, the models can be categorized as 'direct-access' or 'reconstructive'. The former postulate that date information is actually stored in memory, the later suggesting it is reconstructed at the time of recall. Friedman and Wilkins (1985) summarize five proposed models;

> "(1) that events are organized in memory in a time-ordered format, (2) that explicit time tags are laid down at the time of encoding, (3) that decay of trace strength provides time information, (4) that events are inter-related by order codes, and (5) that idiosyncratic contextual information associated with a trace is used to deduce the time of events." (p. 168)

Models 1, 2, 3 and 4 fall into the direct-access category; date information being associated with an event's memory trace. Model 5, on the other hand, suggests that date information is reconstructed using the information stored in memory about the event.

The direct-access models were developed on the basis of serial position and recency experiments, the nature of which has already been described in Section 1.3.3. The relevance of this type of research to the answering of questions such as "When did you break your leg?", has, as already noted, been questioned (e.g., Friedman & Wilkins, 1985; Thompson et al., 1988). The rejection of this type of research and the related temporal models is, however, not simply based on methodological considerations. Rather, it is the results of what might be termed more ecologically valid studies which have not generally found evidence of direct-access to date information, which has led to the abandonment of these models in favour of model 5, or date reconstruction. Extensive discussion of model (3) has already been presented (in Section 1.3.3), and it is evident that trace strength may play some part in event dating. There is, therefore, not a total rejection of the processes proposed by traditional

laboratory research to account for the retrieval of date information. It will also become evident in the following discussion that model (2) is also at least partially correct.

Studies which have required subjects to date autobiographical and public events have consistently found evidence that dates are generally reconstructed, rather than directly recalled (e.g., Baddeley et al., 1978; Brown et al. 1986; Bruce & Van Pelt, 1989; Friedman & Wilkins, 1985; Linton, 1975; Loftus & Marburger, 1983; Robinson, 1986; Thompson, 1982; Thompson et al., 1988; Wagenaar, 1986; White, 1982). However, there is general agreement that date reconstruction requires some direct access to date information, that is the actual date of some events, often termed 'landmark events' (Brown et al., 1986; Lieury et al., 1980; Linton, 1975; Loftus & Marburger, 1983), can be directly recalled. Specifically, the reconstructive model of event dating has been developed on the basis of studies which have required subjects to verbalize or record the sequence of deductions made during an attempt to date an event (e.g., Baddeley et al., 1978; Brown et al., 1986; Friedman & Wilkins, 1985; Linton, 1975; Thompson, 1982), by providing subjects with 'landmark' events and examining the date responses made (e.g., Loftus & Marburger, 1983; Robinson, 1986; Thompson et al., 1988), and on the basis of experimenters' introspective conclusions (e.g., Lindsay & Norman, 1972; Wagenaar, 1986; White, 1982).

The general nature of the reconstruction of an event's date is illustrated by the following example. Two friends meet; one remarks that the last time they saw each other was at Jeff's party, the other replies "When was that?". The actual date of 'Jeff's party' may be remembered, in which case the reconstructive approach would define this event as a 'land-mark event'. Alternatively, there may be no direct access to the event's date, in which case the individual would try to determine it using another landmark event and information recalled about the event. He may remember that Jeff's party occurred some time after his brother's wedding for which he can remember the date. Furthermore, he may remember that at Jeff's party everyone was swimming, and it was therefore probably in the summer. Now he knows the wedding was in October (spring) and that Jeff's party was sometime after it in the summer. On the basis of these deductions he might place Jeff's party in the month of November or December in the year of the wedding. Thus, date reconstruction relies on the individual's ability to recall the actual date of an

event that occurred before or after the event to be dated, the use of a landmark event, and knowledge of routines and normal behaviour patterns.

Considerable attention has been focused on the nature of, and use of, landmark events. Wagenaar (1986) in a study of the efficiency of different event aspects (e.g., what, where, who and when) as cues to autobiographical event memory retrieval found that 'when' an event occurred was a sufficient cue for memory retrieval, although not very often. Reynolds and Takooshian (1988) also found evidence that some subjects could recall experiences on the bases of date information only. These results support the proposition that date information is stored in the memory representation of some events. Landmark events are, however, not exclusively personal or idiosyncratic, other events such as public holidays (e.g., New Year's Day, Waitangi Day, Christmas Day), annual celebrations (e.g., Valentine's Day, Mother's Day) and significant public events (e.g., political incidents) can also be used. Research has, however, found that subjects generally prefer to use personal landmark events when dating events (e.g., Brown et al., 1986; Friedman & Wilkins, 1985; Lieury et al., 1980). Although Brown et al. (1986) did find in relation to the dating of political events that more public facts (e.g., political terms, political incidents) were used to deduce the dates than autobiographical events.

It has also been found that subjects with more landmark events available date events more accurately (e.g., Thompson, 1982) and dating accuracy is increased if the available landmark events are personal or autobiographical (e.g., Baddeley et al., 1978). The type of personal landmark event used to deduce a date may also affect dating accuracy: White (1982) noted that dates assigned to events which occurred within a holiday were particularly accurate. Providing subjects with landmark events has also been reported to increase dating accuracy (e.g., Loftus & Marburger, 1983; Robinson, 1986), a finding which supports the suggestion made by researchers interested in survey response errors (e.g., telescoping effects) that providing a landmark event to define one end of a reference period, for example sending out a letter, rather than using a statement like 'in the last 12 months'; may reduce response errors (e.g., Cartwright, 1963; Gray, 1955; Kemsley, 1979).

Finally, Robinson (1986) uses the term temporal reference system to define the cognitive representation of landmark events, and suggested that landmark events may not be evenly distributed across any particular year or

month. In other words, such events may be available for the dating of some events but not others.

In conclusion, duration estimates and the assignment of dates to events appear to show similar errors: there is the tendency for duration to be under- and over-estimated for long and short intervals respectively, and for the age of events to be under- and over-estimated for remote and recent events respectively. However, in other respects, particularly the models proposed to account for the processes (duration estimation and event dating), there appears to be little similarity. It is true that event dating can be used to produce a duration estimate, but it may be that these types of estimates are not produced in the same way as other types of duration estimates.

CHAPTER 2

RETROSPECTIVE DURATION ESTIMATION OF PUBLIC EVENTS

2.0 Introduction

Chapter 2 contains four experiments on the estimation of public event duration. Experiment 1 examines the validity of subjective knowledge ratings. Experiment 2 obtains estimates of the durations of public events, and examines Ornstein's (1969) 'storage size' model of duration estimation. The knowledge rating scale assessed in Experiment 1 is used in this experiment to measure event knowledge. Although some support for Ornstein's model of duration estimation was found in Experiment 2, other results of this experiment prompted the formulation of a reconstructive model of duration estimation. Experiment 3 obtains frequency of occurrence estimates of public events in order to investigate the reconstruction of public event duration. Experiment 4 obtains duration estimates of both specific public events and general types of public events, and examines predictions made on the basis of the reconstructive model of duration estimation.

2.1 Experiment 1: Validation of Subjective Knowledge Ratings

This experiment investigates subjects' ability to use a seven point rating scale to give knowledge ratings of public events. Subjects' demographic characteristics were also examined to determine if they affected knowledge ratings. In order to test Ornstein's 'storage size' hypothesis it is essential that knowledge ratings validly reflect event knowledge. A knowledge rating scale could produce unreliable ratings if, for example, the subjects deliberately distorted their ratings to impress the experimenter, used the scale in an idiosyncratic way, or simply rated the event description on whether or not they considered that event should have been remembered regardless of whether or not they actually remembered it (Thompson, 1982). Furthermore, because it was proposed to use mean knowledge ratings when analysing the results (that is, averaged over subjects for each event), it was essential that the effect on knowledge ratings of subjects' demographic characteristics be determined. If,

for example, knowledge ratings varied systematically with age, the calculated mean would not reliably reflect subjects' event knowledge.

Collecting recall protocols and counting the number of atomic propositions is one method of objectively validating knowledge ratings (e.g., Brown, Rips & Shevell, 1985). This technique, however, requires considerable time to analyse the protocols, and classifying each proposition as true or false is susceptible to error. Instead, subjects in Experiment 1 were presented with propositions relating to specific events and were required to classify each as true or false, that is, a true/false recognition task. A positive relationship between the subjects' ability to correctly classify propositions for each event and their knowledge ratings for the events would suggest that the knowledge rating scale is a valid instrument for measuring event memory. Scale validity would also be implied if there was a systematic change in knowledge ratings with event rehearsal and time since the event's occurrence.

2.1.1 Method

Questionnaire

Chronological sources (e.g., Grun, 1975; Hodson, 1984; Reed, 1979; Trager, 1979) and editions of 'The Press' (a Christchurch daily newspaper) were systematically searched for suitable public events. An event was selected if it satisfied two criteria. First, each event had to have a definite duration marked by a distinct beginning and end. Second, the event had to be unique in at least one aspect, thus ensuring the event would not be confused with a similar event that had occurred earlier or later. Thirty-six public events occurring between 1978 and 1986 were obtained. An 'event description' was formulated for each event, actual examples include: "Mr Aldo More, former Prime Minister of Italy, was kidnapped by the Red Brigade urban-guerilla group. Sometime later his body was found in the boot of a car in central Rome", and " Pope John Paul II went to Poland to visit his homeland. It was the first visit by a Pope to a communist country". Each of the 36 event descriptions was assigned randomly to a position in the questionnaire. The 36 complete event descriptions are listed in Appendix A; for the purposes of discussion, event description abbreviations are used, these are also shown in Appendix A. Each event description was followed by a knowledge rating scale and two scales

relating to event rehearsal. A true/false recognition task was also included for eleven of the events.

Response choices on the seven point knowledge rating scale were defined as follows: (1) I can not remember this event, (2) I can just barely remember it, (3) I remember it but not so well, (4) I remember it fairly well, (5) I remember it very well, (6) I remember it almost perfectly, and (7) I remember it perfectly. This scale is similar to that developed by Herrmann and Neisser (1978) and those used by Brown et al., (1985) and Thompson (1982, 1985a, 1985b). The two event rehearsal scales also had seven points. Only the end points of each scale were defined. The first scale was of frequency of event rehearsal with response choices ranging from (1) Once, to (7) Very frequently; and the second, of the recency of event rehearsal, with response choices ranging from (1) In the week following the event, to (7) In the last week. Space was also provided for the subject to indicate if no instance of event rehearsal could be recalled.

The true/false recognition task, included for eleven of the events, consisted of five true and five false propositions. The true propositions were taken directly from media reports. False propositions were generated by the experimenter to appear plausible in relation to the event. Care was taken to ensure that no proposition could be rated on the basis of general knowledge (see Appendix B for the eleven events and associated true/false propositions). The task was scored out of ten, one being given for each correct answer.

Questions relating to sex, age, education and newspaper reading habits were located on the cover page, as were the subject instructions. The subjects' newspaper reading habits were assessed in relation to one newspaper, 'The Press' (a Christchurch daily). A three point scale was used with response choices being defined as follows: (1) I never read this newspaper, (2) I occasionally read it, and (3) I read it every day.

Subjects

Fifty-six females with an age range of 17 to 71 years and forty-two males with ages ranging from 17 to 75 years completed the questionnaire. A 'haphazard' sampling technique was used, i.e. available individuals.

Procedure

The questionnaire was distributed in December 1986. A stamped, addressed envelope was supplied so that respondents could return the questionnaire by post. Ninety-eight of the one-hundred-and-thirty questionnaires distributed were returned by the 1st of April 1987.

Respondents were instructed to read each event description carefully, to use the knowledge rating scale to indicate how much they remembered of the event, to indicate, if appropriate, both the recency and frequency of event rehearsal on the scales provided and finally, where appropriate, to read each true/false proposition and indicate if it was true or false by placing a T(true) or F(false) alongside.

2.1.2 Results and Discussion

Subjects' knowledge ratings and scores on the true/false recognition task were correlated for each of the eleven events. Table 2.1 lists the obtained correlation coefficients; knowledge ratings were generally positively correlated with performance on the recognition task, with all five significant correlations being positive.

The correlations between the true/false recognition task scores and knowledge ratings might have been expected to be slightly higher. However, without knowing most of the details associated with an event it would be difficult to score highly on the recognition task, although the recallable event related information may have been such that the subject gave relatively high knowledge ratings.

A number of analyses were conducted with the data averaged over subjects and using the 36 events as the random variable. Mean knowledge ratings were positively correlated with both frequency ($r = .86, p < .01$) and recency ($r = .69, p < .01$) of event rehearsal. Furthermore, a significant negative correlation was obtained ($r = -.34, p < .05$) between the mean knowledge ratings and the age of the events.

Brief Event Description	Event Description Abbreviation	Correlation Coefficient
Soviet submarine detained by Sweden	SS	.12
Suspected foot & mouth outbreak N. Z.	TPF	.23 *
Rebels seize Great Mosque	GMM	-.31
Maori protest march	H	-.11
Pacific Charger runs aground	PC	.25
London, police besiege Libyan Bureau	YF	.43 ***
Nation-wide search for psychiatric patient	BDC	.22
Nicholas Daniloff arrested	NC	.30 **
Paul McCartney arrested	PMC	.23 **
Royals visit New Zealand	R	.07
Climbers trapped on Mount Cook	MC	.31 **

Note - Significance levels are for two-tailed tests.
* P<.05, ** P<.01, *** P<.001

Table 2.1. Product-moment correlation coefficients obtained between event knowledge ratings and true/false recognition task scores.

For 16 of the events (SAH, PII, CD, A, SB, OUE, GMM, TJC, TPF, PC, ST, F, MC, AB, BDC, JK) a 'media coverage' variable was obtained. This involved counting the number of articles about each event published in 'The Press' (a Christchurch daily newspaper) during the time of the event's occurrence. A significant positive correlation ($r = .64$, $p < .01$) was obtained between the mean knowledge ratings and media coverage for the 16 events.

The results obtained with the recognition task suggest that the knowledge rating scale gives an approximate indication of how much individuals knew about particular events. This argument is strengthened by the correlation of the knowledge ratings with the rehearsal ratings and the finding that more distant events were less well-known. The media coverage analysis also suggests that the knowledge ratings are valid, as they appear to be sensitive to initial between-event information differences. Overall the results of the knowledge rating scale analyses are consistent with the findings of other studies which have examined the validity of similar scales using objective measures (e.g., Brown et al., 1985; Thompson, 1982).

Further analyses were performed in order to determine if subject characteristics affected knowledge ratings. The age and education of the subject

were correlated with their average knowledge rating, averaged over the 36 events. Knowledge of the events as a whole increased with age ($r = .39$, $p < 0.01$), but not significantly with years of education ($r = .05$, n.s.). A number of studies have reported that media use increases significantly with age (e.g., McCombs & Poindexter, 1983; Schramm & White, 1949), and particularly during the early teenage years (Peterson, Jensen & Rivers, 1965; Schramm & White, 1949). Moreover, age is positively related to objective measures of public event knowledge (Atkin & Gantz, 1978; Chaffee, Ward & Tipton, 1970; Conway, Stevens & Smith, 1975). Therefore, the obtained relationship between event knowledge and age may have resulted because older subjects obtained more information about the events at the time of their occurrence. However, there was no significant relationship found here between the subjects' media use, as measured by ratings on the newspaper reading scale, and age ($r = .09$, n.s).

It is possible that the obtained relationship between event knowledge and age was found because some of the younger subjects were not actively using the media as a source of public event information at the time some of the earlier events occurred. The acquisition of public event information after an event's occurrence has been investigated by asking individuals about events that they were too young to have experienced at the time of the event's occurrence (e.g., Squire, 1974; Squire, Chace & Slater, 1975; Warrington & Sanders, 1971). Generally, the stimulus events occurred before the individuals were 12 years of age, and the consistent finding is that these individuals perform poorly on the questions. Twenty-four of the subjects in this study were under the age of 12 when 12 of the events occurred.

The data was also examined for sex differences. No significant difference was found between the sexes for newspaper reading, X^2 (3, N = 98) = 0.972, n.s., or knowledge of the events as a whole F (1, 97) = 0.012, n.s.

Overall, the results suggest that the knowledge rating scale provides an adequate measure of subjects' public event knowledge in order to test Ornstein's 'storage size' hypothesis. The sample of public events used also appears adequate as they were sufficiently distributed across time for the knowledge ratings to systematically vary.

The systematic variation in knowledge ratings in relation to the events may reflect differences in the 'degree of original learning' about the events and event rehearsal, and not 'forgetting' or time effects. The results, however, argue against this, particularly the obtained systematic decrease in knowledge ratings as the time since the events' occurrence increased, and the relationship between event knowledge and age. Furthermore, regardless of whether knowledge ratings reflect differences in original learning, rehearsal or forgetting effects, they should still reflect the amount of information the subject can recall when making a duration estimate. According to Ornstein's (1969) 'storage size' hypothesis there should be a relationship between the knowledge ratings and duration estimates, regardless of what factors influence the knowledge ratings. Whether a subject learnt relatively little about an event at the time of its occurrence or forgot information associated with it because it occurred long ago, there will be less information held in memory on which to base a duration estimate.

2.2 Experiment 2: Retrospective Estimates of Public Event Duration

Experiment 1 established that subjects' age was an important factor in determining public event knowledge. In order to help ensure that all subjects had experienced the events, via the media, at the time of their occurrence, age was held constant in Experiment 2. Only twenty year old subjects were used, thus ensuring that all subjects were at least 11 years old when the first event occurred. A slightly older age group might have been preferred; however, it would have been difficult to obtain a reasonable number of older subjects from the under-graduate psychology course at Canterbury University, and the use of a more broadly based sample would have led to variation in education level.

Subjects in this experiment were given brief descriptions of public events, and then asked to rate how much they remembered of each event and to estimate its duration. Estimates were in terms of days, weeks or months. The experimental hypothesis, following Ornstein (1969), was that subjects' duration estimates would be positively related to event knowledge, with better known events being estimated to have lasted for longer. A related hypothesis concerns retention interval, the time between an event's occurrence and its recall. Its is well-substantiated that less information can be retrieved after longer retention intervals. Hence, the duration of older events should be

estimated as shorter than that of more recent ones of comparable actual duration.

2.2.1 Method

Questionnaire

A duration question was formulated for each of the 36 event descriptions used in Experiment 1. For example, for the event, "Pope John Paul II went to Poland to visit his homeland. It was the first visit by a Pope to a communist country", the duration question was "How long was Pope John Paul II in Poland for?" (See Appendix A for the complete set of duration questions). Actual event duration was determined from the media reports associated with the events, the day the event began on and ended on were both counted as a complete day. Actual durations ranged from 2 to 448 days. The actual duration and date that each of the 36 events began on are shown in Table 2.2.

The 36 event descriptions and associated duration questions were assigned randomly to their positions in the questionnaire. Ten different random sequences were used. A knowledge rating scale, identical to that used in Experiment 1, was included after each event description. A question relating to the respondents sex, along with instructions, was located on the cover page.

Subjects

Twenty-three male and 30 female under-graduate psychology students of the University of Canterbury completed the questionnaire. All were 20 years old at the time of the experiment.

Procedure

Subjects completed the questionnaire individually. They were instructed to read each event description, rate how much they remembered of the event on the knowledge rating scale, and then to answer the duration question. It was emphasized that subjects should give a duration estimate even if they could not remember the event itself. Three example questions (not included in the questionnaire) were then displayed on an overhead

projector. These were worked through in order to illustrate the task and help reduce the chances of a systematic improvement in subjects' responses as they completed the questionnaire.

Subjects required approximately 20 minutes to complete the questionnaire. The experiment was carried out in October 1987.

2.2.2 Results and Discussion

Median duration estimates were computed for each of the 36 events. Medians were used, instead of means, because the subjects occasionally made unusually large estimation errors. Table 2.2 shows the median duration estimate, actual duration, date the event began on, mean knowledge rating and median signed error for each of the 36 events (signed error was calculated by subtracting actual event duration from estimated duration). Inspection of the table suggests that, on average, the longer the actual event duration the longer the estimated duration. This result was confirmed by obtaining a significant ($p < .05$) correlation of .66 between the two variables.

The logarithm of the median duration estimates was regressed on the logarithm of the actual durations in order to determine whether the estimation of duration in this study followed Stevens' psychological power law. A slope of 0.50, indicating a power function between the two variables with an exponent of 0.50, and a correlation of 0.69 were obtained. The obtained exponent indicates a tendency for the short duration events to be over-estimated and the long duration events to be under-estimated, but is smaller than the exponent value of 0.90 typically found in traditional duration estimation research (Eisler, 1976). The fact that the actual durations used in this study were substantially longer than those traditionally used may be responsible for this difference. Alternatively, the low correlation between the two variables (logarithm of estimated and actual duration) may have restricted the size of the obtained exponent.

A significant ($p < .05$) negative correlation of -.34 was obtained between the age of the events, determined by the date that the events began on, and the mean knowledge ratings. This result is consistent with the result obtained in Experiment 1, as is the correlation of .58 ($p < .05$) obtained between the knowledge ratings and media coverage variable for the 16 events that the later

Brief Event Description and Abbreviation		Date Event Began on	Actual Duration	Median Duration Estimate	Median Signed Error	Mean Knowledge Rating
Aldo Moro kidnapping	AM	16 Mar 78	55	14.0	-41	1.7
Cook Island's election scandal	SAH	1 Apr 78	117	14.0	-103	1.8
Pope John Paul I's reign	PPI	27 Aug 78	33	90.0	57	2.8
Pope John Paul II visits Poland	PPII	2 Jun 79	9	7.0	-2	3.1
Carless days in New Zealand	CD	30 Jul 79	319	240.0	-79	3.9
Abbotsford emergency	A	6 Aug 79	36	13.0	-23	3.4
Soviet Airliner held in New York	SB	26 Aug 79	3	2.0	-1	1.4
U.S. Embassy occupation	OUE	4 Nov 79	442	28.0	-414	2.4
Great Mosque seized	GM	20 Nov 79	14	6.0	-8	1.5
Paul McCartney arrested	PMC	14 Jan 80	12	4.0	-8	2.4
Hostages Iranian Embassy London	IEL	30 Apr 80	7	4.0	-3	2.2
Mangere College play	MP	3 May 80	3	7.0	4	1.1
Clark murder trial	TJC	6 Jan 81	123	36.5	-86	2.7
Walesa visits Rome	LW	13 Jan 81	7	7.0	0	1.6
Suspected foot and mouth outbreak	TPF	11 Feb 81	11	7.0	-4	3.2
Pacific Charger runs aground	PC	21 May 81	15	6.0	-9	2.1
Springbok tour	ST	19 Jul 81	55	21.0	-34	4.5
Rexin Industrial sit-in	RCF	1 Sep 81	96	5.0	-91	1.3
Sweden detains Soviet submariane	SS	27 Oct 81	11	14.0	3	2.1
Falkland's war	F	2 Apr 82	73	35.0	-38	4.5
Climbers traped on Mount Cook	MC	15 Nov 82	14	6.0	-8	3.8
Dozier kidnapping	JD	17 Dec 82	42	21.0	-21	1.4
Australian bushfire	AB	16 Feb 83	2	12.5	10.5	3.2
Royals visit New Zealand	R	17 Apr 83	13	7.0	-6	3.5
Discovery of Hitler Diaries	S	22 Apr 83	17	21.0	4	3.4
Mario protest march	H	28 Jan 84	10	5.0	-5	2.2
Search for psychiatric patient	BDC	22 Feb 84	9	9.5	0.5	2.0
Police besiege Libyan Bureau London	YF	17 Apr 84	10	3.0	-7	2.6
Gloria Kong kidnapping	GK	29 Jun 84	3	4.0	1	3.2
John Kirk extradited from U.S.A.	JK	7 Jul 84	448	134.0	-314	3.5
Wizard temporarily resigns	W	3 Sep 84	30	21.0	-9	3.1
Baby Fae heart transplant	BF	26 Oct 84	22	14.0	-8	2.6
Riots in New Caledonia	NC	12 Jan 85	2	10.5	8.5	2.1
Achillo Lauro hijacked	AL	7 Oct 85	3	5.5	2.5	2.3
Daniloff arrested	ND	29 Aug 86	13	26.0	13	2.8
Stars & Strips beats KZ7	KZ7	5 Oct 86	12	28.0	16	4.8
Overall (means)			58.08	24.6	-33.3	2.6

Table 2.2. Beginning date, actual duration, median duration estimate, median signed error, and mean knowledge rating for each event used in Experiment 2.

variable was obtained for. Thus, as Ornstein (1969) predicted, event knowledge did decrease as the age of the event increased. However, there was no significant correlation between actual event date and median estimated

duration (r = -.10), which is not consistent with Ornstein's (1969) suggestion that

> "when some period elapses before an interval is to be judged . . some items should drop out of storage and the experience of duration of that interval shortens." (p. 48)

Nor was there a significant correlation between the actual date that the event began on and the event's actual duration (r = -.15), which rules out the possibility that this result was obtained because the older events were actually of long duration and recent events of short duration.

As no significant relationship was found between event knowledge (mean knowledge ratings) and actual event duration (r = .15) it was possible to directly examine Ornstein's predicted relationship between event knowledge and estimated duration.

Correlating median duration estimates and mean knowledge ratings produced a moderate, yet significant ($p < .05$) correlation (r = .35); thus, the better known events were on average estimated to have lasted longer. This result provides some support for Ornstein's (1969) 'storage size' hypothesis. However, inspection of the median signed error scores shown in Table 2.2 indicates that for 24 of the events the subjects generally underestimated the events' duration. The overall median signed error (-6.5 days) is further evidence of this general tendency. Therefore, the observed positive relationship between event knowledge and duration estimation might be alternatively explained as a tendency for estimated duration to increase in accuracy, that is, move toward actual event duration as event knowledge increases.

Further analyses used subjects as the random factor. Knowledge ratings were correlated with duration estimates for each of the 36 events: only two significant ($p < .05$) positive correlations were obtained; of the remaining 34 correlations, 12 were negative. Furthermore, when subjects' event knowledge ratings were added to produce a knowledge rating sum for each subject, and duration estimates treated similarly, the correlation of the two sums was very low (r = -.04). Mean knowledge ratings and median absolute error (absolute error was calculated by subtracting the actual event duration

from the estimated event duration and ignoring the sign) were also correlated for each event separately. Four significant ($p < .05$), and 14 non-significant negative correlations were obtained, the remaining correlations were positive but extremely low. Subjects' event knowledge rating sum was also correlated with their absolute error sum. The obtained negative correlation ($r = -.19$), although not significant, does, when considered with the above results, support the suggestion that event knowledge is positively related to estimation accuracy rather than directly related to the size of the duration estimate as suggested by Ornstein (1969).

In order to examine the effect of event knowledge on duration estimation more closely, further analyses were performed. First, the knowledge ratings for each subject and event were dichotomized. Knowledge ratings of 1 ("I can not remember the event") were taken to be indicative of forgotten events or events that the subject had not heard of. Events given a knowledge rating from 2 to 7 were taken to be remembered events. Then, for each event, the median duration estimate of those subjects who could not remember the event was calculated and, similarly, the median duration estimate of subjects who remembered the particular event. The number of subjects who did or did not remember the event varied with the event and there were three events (CD, ST, and F) which were remembered by all the subjects.

Table 2.3 shows the median duration estimate for each of the events given by each group, that is subjects who remembered, and those who did not remember the event. The number of cases each median is based on and actual event duration are also shown. Inspection of the median duration estimates shown in Table 2.3 indicates they are generally quite similar between the groups, even were the number of subjects in each group varied markedly. Indeed, for six of the events the median duration estimates are identical for the two groups.

When the two groups of estimates were compared (over the 33 events for which both remembered and not remembered estimates were available) no significant difference was found (t (32) = -.82, n.s). This result indicates that the two groups of estimates were similar. Further evidence of this was found when the median signed error of the estimates (t (32) = 0.82, n.s) and the

Event Description Abbreviation	Actual Duration	Median Duration Estimate (Days) Not-Remembered	Median Duration Estimate (Days) Remembered	N= Subjects Not Remembering Event	N= Subjects Remembering Event
AM	55	10	20.5	31	22
SAH	117	14	14	28	25
PPI	33	330	73.5	10	43
PPII	9	12	7	4	49
CD	319	-	240	0	53
A	36	7	14	6	47
SB	3	2	2	40	13
OUE	442	6	63	18	35
GMM	14	6	4	36	17
PMC	12	3	5	17	36
IEL	7	3	4	21	32
MP	3	7	9	50	3
TJC	123	90	29.5	11	42
LW	7	7	5	31	22
TPF	11	6	7	7	46
PC	15	6	7	24	29
ST	55	-	21	0	53
RCF	96	4	8	43	10
SS	11	14	14	24	29
F	73	-	35	0	53
MC	14	5	6.5	3	50
JD	42	21	38.5	45	8
AB	2	9	13	2	51
R	13	14	7	4	49
S	17	43	21	6	47
H	10	3	6	16	37
BDC	9	10	7	24	29
YF	10	3	3	18	35
GK	3	4	4	8	45
JK	448	135	104	2	51
W	30	8	23	9	44
BF	22	14	14	9	44
NC	2	5	17	19	34
AL	3	7	5	25	28
ND	13	21	28	12	41
KZ7	12	8	28	1	52

Table 2.3. Median duration estimate for each event for subjects that did and did not remember the event , and the number of subjects in each group.

median absolute error of the estimates (t (32) = 0.96, n.s) of each group was compared. Correlating actual and estimated duration, however, produced a significant (p < .01) correlation (r = .79) for the remembered event group but not for the forgotten event group (r = .34), which is consistent with the suggestion that event knowledge increases estimation accuracy.

The overall effect of these analyses is to call the meaning of the correlation between median duration estimates and mean knowledge ratings into question. Although the existence of this correlation provides some support for Ornstein's (1969) hypothesis, the finding that estimates were generally underestimations and that increased event knowledge decreased the size of the underestimation argues for an 'estimation accuracy' explanation of the event knowledge effect. However, the degree to which an event is remembered has only a small effect on estimated duration. Indeed, not remembering the events at all did not significantly increase estimation error or change the nature of the estimates made when compared with estimates given by subjects who remembered the event.

These results can be interpreted in two ways; either the duration estimates obtained in this study were simply guesses, or they were generated by some kind of inferential or reconstructive process. The similarity seen in the estimates provided by subjects that did and did not remember the events suggests that both groups of subjects used a similar duration estimation process. Several findings argue against the estimates being simply guessed: firstly, there is the event knowledge effect, secondly, the obtained correlation between actual and estimated event duration, and, finally, the fact that the estimates were, in general, reasonably accurate. Therefore, the use of a reconstructive duration estimation process by the subjects seems the most plausible explanation of the results, particularly, considering it can account for the slight effect of event knowledge on estimation accuracy. Such a model of duration estimation is also supported by other research which has demonstrated that recall is often a reconstructive process (e.g., Baddeley, Lewis & Nimmo-Smith, 1978; Barclay, 1986; Bartlett, 1932; Brown, Shevell & Rips, 1986; Friedman & Wilkins, 1985; Linton, 1975; Loftus & Marburger, 1983; Robinson, 1986; Thompson, 1982, Thompson, Showronski & Lee, 1988; Wagenaar, 1986; White, 1982).

Reconstructing event duration may involve the use of: (a) general event knowledge already stored in memory, and (b) information provided in the event description. Individuals are constantly exposed to information on public events. Over time many similar, although distinguishable, events occur. Similar events can be categorized into types (e.g., natural disasters, wars, an official visit to a country). As more instances of a specific type of event are encountered an individual may develop a body of general knowledge

relating to that type of event. Time information, such as event duration, may be part of this general event knowledge. The extent of this general event knowledge, for any specific type of event, might be assumed to vary in relation to the number of category members that have been encountered.

Providing individuals with a specific event description, as was done in this experiment, might allow them to access a specific memory of that event, or to categorize the described event as a particular type and access their general event knowledge for that type of event, or both. The recalled information would, in this case, be used to provide the duration estimate. When both specific and general event knowledge can be recalled, the specific event knowledge may help reduce a reconstructed duration estimate's error if the specific event is not a representative member, in terms of actual duration, of its event category. That is, where the event appears typical of an event category but its duration is atypical for some reason, specific event knowledge could reduce estimation error.

This reasoning provides two testable hypotheses. If the duration of a specific event is estimated by reconstruction from general knowledge of that type of event, then the estimated duration of a specific event should be similar to the estimated duration of the same event described in general terms. Furthermore, if general event knowledge becomes more elaborate as the number of similar events encountered increases, reconstructed duration estimates of frequently occurring events should be more accurate, and show less between-subject variance, than reconstructed duration estimates of less frequently occurring events. Each of these hypotheses is tested in Experiment 4. However, in order to test the latter hypothesis and to access the validity of the assumption it is based on, Experiment 3 was conducted, in which the estimated frequency of public event occurrence is examined.

2.3 Experiment 3: Frequency of Occurrence Estimates of Public Events

The aim of this experiment was to discover how frequently the types of public events used in Experiments 1 and 2 were estimated to have occurred in the previous 10 years. Thirty-three of the event descriptions used in Experiments 1 and 2 were re-worded to form 'general' event descriptions. Subjects were asked to estimate how many times in the previous ten years each type of event had occurred world-wide. The frequency estimates were used to

select ten high and ten low frequency events to be used as the stimuli in Experiment 4.

2.3.1 Method

Questionnaire

Thirty-three of the 36 public event descriptions used in Experiments 1 and 2 were reworded to provide 'general'[1] event descriptions. Generally, this re-wording simply involved replacing place names and individual's names used in the original event descriptions with descriptive terms. For example, the 'Aldo Moro' and the 'Pope John Paul II' events from Experiments 1 and 2 became respectively: "A prominent politician is kidnapped by an urban-guerrilla group. Some time later his body is found.", and "A prominent religious leader made an official visit to a foreign country" (see Appendix C for the 33 general event descriptions).

The 33 general event descriptions were randomly assigned a position in the questionnaire. Each description was followed by the series of numbers 0 to 10, and an open bracket with "more than 10 times" beside it. Questions relating to the respondents' sex and age, along with instructions, were located on the cover page.

Subjects

Twenty-five male and 56 female under-graduate psychology students of the University of Canterbury, with an age range of 17 to 60 years, who had not previously participated in my experiments, completed the questionnaire.

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[1] Event KZ7 was not used as it appeared impossible to reword the event description into a description of a type of event, nor were events CD and F, which were found in Experiment 2 to be remembered by most subjects.

Procedure

Subjects completed the questionnaire individually. They were instructed to read the general event description and to indicate (by circling the appropriate number or ticking the brackets) how many times they considered that type of event had occurred world-wide in the last 10 years. It was emphasized that their responses did not have to necessarily correspond with the number of specific occurrences remembered.

Subjects completed the questionnaire in March 1988, requiring approximately 10 minutes to do so.

2.3.2 Results and Discussion

Table 2.4 shows the median, and upper and lower quartile frequency of occurrence estimates for the 33 general events (response category "more than 10 times" was coded as 11). Both the medians and the inter-quartile deviations were used to select 10 high and 10 low frequency events for Experiment 4. That is, the selected low frequency events have the smallest medians and the smallest inter-quartile deviations, while the selected high frequency events are those with largest medians and smallest inter-quartile deviations. The 10 selected low frequency events are indicated by an 'L' in Table 2.4 and the 10 high frequency events by an 'H'.

The data was examined for sex differences. A comparison of the between-sex frequency estimates for each of the 33 general events only produced one significant result, event PPII (t (79) = 2.20, p < .05). Subjects' frequency estimates were also added to produce an event frequency sum. No significant difference was found when a comparison between the sexes was made on this measure (t (76) = 0.83, n.s). Despite the single significant result obtained, it seems reasonable to conclude that sex has little effect on estimated event frequency. Subject age also appears not to have an effect on estimated event frequency, indicated by the non-significant correlation obtained when subjects' age was correlated with their event frequency estimate sum (r = -0.06, n.s).

Overall, the frequency of occurrence estimates support the suggestion, made in Experiment 2, that general event knowledge may vary between

specific types of events because the number of category members encountered varies. Furthermore, the frequency estimates were sufficiently varied to allow two distinct groups of events (e.g., 10 low and 10 high frequency) to be selected.

Event Description Abbreviation	Event Frequency Estimates			High (H) and Low (L) Frequency Events
	Lower-quartile	Median	Upper-quartile	
AM	2	4	5	
SAH	2	3	5	L
PPI	1	2	3	L
PPII	6	11	11	H
A	10	11	11	H
SB	1	3	6	
OUE	2	4	7	
GMM	2	4	7	
PMC	2	4	7	
IEL	2	4	9	
MP	2	5	8	
TJC	2	3	5	L
LW	2	3	6	L
TPF	2	3	4	L
PC	4	7	11	H
ST	2	4	6	
RCF	4	8	11	H
SS	1	3	4	L
MC	8	11	11	H
JD	2	4	8	
AB	5	7	11	H
R	11	11	11	H
S	2	4	8	
H	11	11	11	H
BDC	1	1	4	L
YF	1	3	6	
GK	4	7	11	
JK	1	2	4	L
W	1	3	6	L
BF	4	7	11	H
NC	8	11	11	H
AL	1	2	4	L
ND	2	5	8	

Table 2.4. Upper and lower quartile, and median frequency of occurrence estimates for each event, and the selected low and high frequency events.

2.4 Experiment 4: Reconstruction In Retrospective Estimates Of Public Event Duration

The 10 low and 10 high frequency public events selected in Experiment 3 formed the stimuli for this experiment. Two parallel questionnaires were constructed, one containing the 20 specific event descriptions as used in Experiment 2, the other the corresponding general event descriptions developed in Experiment 3. Subjects completed either the general or specific event questionnaire. Two experimental hypotheses are tested: firstly, that duration estimates given by subjects who can not remember or never originally heard of a specific event will be similar to estimates made by subjects given a general description of the same event; secondly, that the duration estimates of the high frequency events will be more accurate and show less between-subject variance than those of the low frequency events.

2.4.1 Method

Questionnaire

A duration question was formulated for each of the 10 high and 10 low frequency events selected in Experiment 3. For example, the duration question for the general event description formulated from the Pope John Paul II event (a high frequency event) was "How long did the visit last for?" Five of the duration questions were identical to those used with the specific events in Experiment 2. The remaining 15 had names of people and place names removed or replaced with descriptive terms (these are listed in Appendix C). The 20 general event descriptions and their duration questions were randomly assigned a position in the questionnaire.

A parallel questionnaire was composed by taking the corresponding 20 specific event descriptions and duration questions (as used in Experiment 2) and assigning them to matched positions. A question asking if the subject remembered the event was included after each event description.

Questions relating to the subjects' age and sex, along with instructions were located on the cover page. The two questionnaires are termed respectively, 'the general event questionnaire' and 'the specific event questionnaire'.

Subjects

Subjects completed either the 'general' or the 'specific' event questionnaire. Twenty-one males and 27 females, with an age range of 17 to 41 years, from the Introductory Psychology course at the University of Canterbury, completed the general event questionnaire. Thirty-five male and 64 female subjects from the same groups, with ages in the range of 17 to 45 years, completed the specific event questionnaire.

Procedure

Both groups of subjects were instructed to carefully read each event description and answer the associated duration question. The subjects who completed the specific event questionnaire were also instructed to indicate whether they remembered the event in the space provided.

All subjects completed the questionnaire during laboratory class time, in April 1988, and took approximately 15 minutes to do so.

2.4.2 Results and Discussion

The estimates obtained with the specific event questionnaire were divided into two groups on the basis of whether or not the subject indicated he or she remembered the event. The median duration estimate was then calculated for each event for these two groups and for the general event questionnaire estimates. Table 2.5 shows the 20 median duration estimates for each of these groups, actual event duration is also shown. Inspection of the median duration estimates shown in Table 2.5 suggests they are similar across the groups.

This was confirmed when the three sets of median duration estimates were correlated with each other and actual duration, and paired-sample t -tests performed (the results of these analyses are also shown in Table 2.5). Significant ($p < 0.01$) positive correlations were obtained between all three groups of estimates. Furthermore, no significant differences were found between the three groups of estimates, or between the estimates and actual event durations. The three groups of estimates not only appear to vary similarly with actual event duration, as indicated by the high between-group estimate correlations,

	Event Description Abbreviation	Actual Duration	Median Duration Estimates (Days)		
			General Event Questionnaire	Specific Event Questionnaire: Not-remembered	Specific Event Questionnaire: Remembered
High Frequency Events	PPII	9	7.5	8.5	7
	A	36	10	7	13
	PC	15	10	4	8.5
	RCF	96	4	5	9
	MC	14	4.5	5	7
	AB	2	5.5	5	7
	R	13	9	5	7
	H	10	1	3	3
	BF	22	27	7	12
	NC	2	4	14	14
Low Frequency Events	SAH	117	23	21	23.5
	PPI	33	360	255	90
	TJC	123	105	60	90
	LW	7	14	7	4
	TPF	11	7	5	10.5
	SS	11	26.5	14.5	14
	BDC	9	5	8	6
	JK	448	148	60	120
	W	30	21	21	28
	AL	3	4	5	5
Actual Duration	r		.35	.12	.68**
	t		t(19)=0.47, n.s.	t(19)=0.72, n.s.	t(19)=1.40, n.s.
General Questionnaire	r			.96**	.88**
	t			t(19)=1.75, n.s.	t(19)=1.18, n.s.
Specific Questionnaire: Not-remembered	r				.74**
	t				t(19)=0.45, n.s.

Note- Significance levels are for two-tailed tests * P<.05, ** P<.01

Table 2.5. Median duration estimates obtained with the general events and the specific events from subjects who did and did not remember the events. Between group correlation coefficients (r) and paired-sample t-test results are also shown.

but also show the same extent of estimation error, indicated by the t -test results.

The specific event questionnaire results are consistent with those obtained in Experiment 2 in that estimates given by subjects who did and did not remember the events were very similar. Furthermore, the results support the first experimental hypothesis in that the estimates given by the subjects that did not remember the specific events were highly correlated with those given by subjects presented with a general event description only.

The two groups of median duration estimates obtained in Experiment 2 (i.e., estimates given by subjects that did and did not remember the events) were also correlated with the three groups of estimates obtained in this experiment. Table 2.6. shows the obtained correlations. All six correlations

		Experiment 4		
		General Event Questionnaire	Specific Questionnaire: Remembered	Specific Questionnaire: Not-remembered
Experiment 2	Remembered Event Median Estimates	.79**	.92**	.64**
	Not-remembered Event Median Estimates	.99**	.87**	.96**

Note- Significance levels are for two-tailed tests * P<.05, **P<.01

Table 2.6. Correlations between the median duration estimates obtained in Experiment 2 and Experiment 4.

are significant ($p < .01$), and also appear to vary systematically. The correlation between the two groups of subjects that did not remember the events is very high, as is the correlation between the two groups that did remember the events. Furthermore, the general event questionnaire estimates show a stronger relationship to the not-remembered estimates from

Experiment 2; a similar result to that obtained in this experiment and shown in Table 2.5.

The correlations between actual and estimated event duration obtained in this experiment and shown in Table 2.5, for the remembered and forgotten event estimates, also show similar between-group variation to those observed in Experiment 2 (e.g., $r = .79$, $p < .01$ and $r = .34$, n.s., respectively). Again, the only significant correlation ($p < 0.01$) is between the remembered event median estimates and actual event duration, suggesting that the relationship between event knowledge and duration estimation observed in Experiment 2 is reasonably reliable.

In order to assess further the proposition that the estimates given by subjects that did not remember the events and those based on general event descriptions were not simply guesses, between-group estimation accuracy was

			Specific Event Questionnaire: Not-remembered	Specific Event Questionnaire: Remembered
General Event Questionnaire	Absolute Error	r	.98**	.82**
		t	t(19)=1.46, n.s.	t(19)=0.90, n.s.
	Signed Error	r	.98**	.86**
		t	t(19)=1.75, n.s.	t(19)=1.18, n.s.
Specific Event Questionnaire: Not-remembered	Absolute Error	r		.88**
		t		t(19)=1.50, n.s.
	Signed Error	r		.91**
		t		t(19)=0.45, n.s.

Note- Significance levels are for two-tailed tests * P<.05, ** P<.01

Table 2.7. Between groups absolute and signed error score correlation coefficients (r) and t-test results.

examined. Absolute and signed error scores were calculated for each of the three groups of estimates obtained in this experiment (the procedures involved for calculating error scores were identical to those used in Experiment 2). The error scores for each of the three groups of estimates were correlated and compared for significant differences. The obtained correlations and paired-sample *t* -test results are shown in Table 2.7. All of the between-group absolute and signed error score correlations were significant ($p < 0.01$) and none of the paired-sample *t* -test comparisons produced a significant difference. In general all of the correlations are reasonably high, and, when considered with the *t* -test results, suggest that the subjects who did not remember the events and those given only general event descriptions made very similar estimation errors to those subjects who actually remembered the events. These results provide further evidence that event knowledge has only a slight effect on duration estimation accuracy. Furthermore, the similarity in errors between the three groups strengthens the argument for a duration estimation process which goes beyond simple guessing. Overall the results support the alternative explanation that event duration was reconstructed.

The second experimental hypothesis, that 'duration estimates of the high frequency events will be more accurate and show less between-subject variation than those of the low frequency events', focuses on the effect of 'past experience' in the reconstructive duration estimation process. In order to test this hypothesis the duration estimates of the 10 high and 10 low frequency events were compared in terms of median absolute error and standard deviation for each of the three groups. Because the actual durations of the high and low frequency events were different, comparisons were performed using analysis of covariance with actual event duration as the covariate.

Table 2.8 shows for each group of estimates the median absolute error and standard deviation for each of the high and low frequency events. Overall means are also shown in the table, as are the adjusted means (adjusted for the effect of the covariate, actual event duration). Although the adjusted means, for both absolute error and standard deviation, all vary in the predicted direction between the high and low frequency events none were found to be significantly different. However, when the standard deviations of the general event

	Event Description Abbreviation	General Event Questionnaire		Specific Event Questionnaire: Not-remembered		Specific Event Questionnaire: Remembered	
		Median Absolute Error	Standard Deviation	Median Absolute Error	Standard Deviation	Median Absolute Error	Standard Deviation
High Frequency Events	PPII	5.0	14.33	5.0	10.69	4.0	20.09
	A	26.0	12.31	31.0	22.55	26.0	35.57
	PC	10.5	80.25	12.0	15.08	10.0	22.67
	RCF	92.0	64.77	91.0	10.34	87.0	9.21
	MC	10.0	5.06	10.0	6.86	8.0	5.23
	AB	3.5	5.93	3.0	3.75	5.0	10.95
	R	6.5	12.88	8.0	4.91	6.0	6.29
	H	9.0	2.13	8.0	16.62	7.0	5.43
	BF	13.0	37.46	15.5	16.81	13.0	11.58
	NC	2.0	52.32	12.0	27.81	12.0	58.45
	Mean	17.75	28.74	19.55	13.54	17.90	18.55
	Mean (adjusted)	35.52	36.21	42.84	22.22	38.87	25.81
Low Frequency Events	SAH	96.0	116.10	96.0	29.81	96.0	117.0
	PPI	327.0	375.70	222.0	211.16	57.0	174.42
	TJC	87.5	190.15	63.0	57.68	81.0	151.42
	LW	7.0	12.92	4.0	7.49	4.0	6.21
	TPF	8.5	13.29	6.0	17.58	4.0	25.78
	SS	15.5	147.32	8.0	81.45	8.0	37.08
	BDC	6.0	26.68	5.0	10.72	5.0	7.72
	JK	309.0	190.06	388.0	202.77	328.0	139.09
	W	23.0	174.71	16.0	135.99	23.0	63.44
	AL	1.5	4.60	2.0	6.18	2.0	5.94
	Mean	88.10	124.75	81.0	76.08	60.80	72.81
	Mean (adjusted)	70.34	117.29	57.72	67.40	39.83	65.55

Table 2.8. Median absolute error and standard deviation for each of the high and low frequency events for each group.

questionnaire and the specific event questionnaire not-remembered estimates were averaged, the difference between the high and low frequency events standard deviation was found to be significant (F (1,17) = 4.436, $p < .05$), with the high frequency events' adjusted mean standard deviation (29.20) being smaller than the low frequency events' (92.56). No other significant differences were found for either standard deviation or absolute error when averaged across different groups of estimates.

Overall these results suggest that the duration estimates of all the groups probably were largely reconstructed. The consistency of the direction of the adjusted mean differences for both absolute error and standard deviation across the three groups further strengthens this argument.

2.5 General Discussion

In line with Ornstein's (1969) 'storage size' hypothesis, at least part of the variance in public event duration estimates appears to be accounted for by the subjects' event knowledge, with an increase in event knowledge producing an increase in the size of the estimated duration. However, because the actual duration of the events was generally underestimated and event knowledge decreased the size of the underestimation, event knowledge can be interpreted as increasing estimation accuracy. This interpretation of the part event knowledge plays in duration estimation is markedly different from Ornstein's which suggests a direct relationship between event knowledge and estimated duration. Indeed, ample evidence was found that knowledge of an event was not at all necessary for a reasonably accurate estimate of its duration to be given. Clearly the estimation of public event duration is not based solely on the amount of stored event information.

Two alternative explanations of public event duration estimation were suggested in Experiment 2; that the estimates were simply guesses, or they were reconstructed on the basis of general and specific event knowledge. The general accuracy of the estimates and their consistency, both across the experiments and the different experimental groups, together with the actual duration and event knowledge effects, argue against the guess explanation. Furthermore, the predictions made on the basis of the proposed reconstructive model of duration estimation were largely confirmed in Experiment 4. A general event description was sufficient to produce estimates similar to those given on the basis of a specific event description by both subjects who did and did not remember the specific events. Thus, the event description supplied probably was used by all the subjects to categorize the event and access their general knowledge of that type of event. The finding that the accuracy and variance of the high and low frequency events varied in the predicted direction, although not significantly so for accuracy, supports the suggestion that the extent of general event knowledge of any specific type of event is likely

to vary in relation to the number of specific events of that type encountered in the past.

The reconstructive model of public event duration estimation also adequately accounts for the moderate effect of event knowledge. Specific event knowledge probably allowed the subjects to adjust a reconstructed estimate when the particular event that a duration estimate was required for was not typical in terms of duration of its category. It is also probably true that the duration of a type of event is less stable than other factors that determine category membership. That is, all events, such as kidnappings, are characterized by some aspects - someone is taken, money or something is demanded - which are probably rather consistent across different kidnappings. The duration, however, probably varies rather more. Therefore, knowledge of a specific example of a kidnapping may not only help refine a reconstructed estimate when the duration of the event is definitely atypical but even when it is typical.

General time knowledge is probably not stored in memory as a separate body of knowledge. Rather, as suggested in the reconstructive model of duration estimation, it is associated with specific types of activities and events. That is, temporal information, including duration where appropriate, is a part of what Schank and Abelson (1977) call a script or a standardized generalized memory representation of an event which is developed on the basis of encounters with many similar events. As similarities between events are noted they are formed into that type of event's script structure. Schank and Abelson also suggest that the particulars of a specific event for which one already has a script are only stored in memory if they are significantly different from those already contained in the standardized script. This reasoning is in line with the explanation of the event knowledge effect on duration estimation observed in this study.

The formulation of a reconstructive model of duration estimation to explain the results of this study is not surprising. Firstly, as noted in Chapter 1, duration estimation research has typically required the estimation of rather meaningless intervals of time which deny subjects the opportunity to use a reconstructive strategy. It is, therefore not surprising that Ornstein's model could not adequately explain the present results, as his model was developed on the basis of traditional duration estimation research. Secondly, as note in

section 2.2.2, there is ample evidence that responses are often reconstructed rather than recalled (e.g., Bartlett, 1932; Corbonell & Collins, 1973; Collins, 1978; Collins, Warnock, Aiello & Miller, 1975; Genter & Collins, 1981). In relation to temporal information, specifically the recall of when an event occurred, the dominant explanation is a reconstructive one (e.g., Baddeley, Lewis & Nimmo-Smith, 1978; Brown, Shevell & Ripps, 1986; Linton, 1975; Loftus & Marburger, 1983; Robinson, 1986; Thompson, 1982, Thompson et al., 1988; Wagenaar, 1986; White, 1982), which incorporates the use of general time knowledge about natural temporal patterns, activity routines, and autobiographical and social information (Friedman & Wilkins, 1985). The results of this study suggest that event duration is similarly reconstructed.

CHAPTER 3

THE UNDIRECTED-DIARY METHOD

3.0 Introduction

Obtaining diaries compiled by individuals (diarists) who have no prior knowledge of their use in research and examining the diarist's recall of the autobiographical events detailed therein is a method that has not previously been employed by memory researchers. This method, termed the 'undirected-diary method', is used in Experiment 6. It is proposed that this method overcomes a number of the problems associated with some of the methods currently used in autobiographical memory research. In this chapter, the undirected-diary method is compared with other methods of studying autobiographical memory.

The chapter is organized into four sections. In the first, methods that have been used to study autobiographical memory are described. Sections two and three focus on diary-keeping. Section two briefly outlines the history of diary-keeping and the various ways in which diaries have been used in research. The characteristics of diarists, diary-keeping as a behaviour, and diary records are examined in Section three, where the results of a questionnaire survey of diarists (Experiment 5) are given. Section four compares the undirected-diary method to other methods that have been used to study autobiographical memory. The general focus of the chapter is to determine the research potential of the undirected-diary method in the study of autobiographical memory.

3.1 Autobiographical Memory Research Methodology

In this section methods that have been used to investigate autobiographical memory are described. In line with the definition of autobiographical memory given in Chapter 1, Section 1.2, only methods which have been used to study people's memory of real-life incidents which they have personally experienced are examined. Table 3.1 describes five

methods that have been used to investigated various aspects of autobiographical memory, and lists studies which have used each method. Although the objectives of the various studies listed in Table 3.1 are not particularly relevant to the present discussion, this information is presented in the table.

Table 3.1. Methods that have been used to investigate autobiographical memory and studies that have used each method.

Section 1: The Diary Method

Subjects are instructed to record in a diary specified details of particular events at the time of the events occurrence. Subject's records are collected and compared with their subsequent recall of the recorded material. Details of a record can also be used as a prompt for recall or the complete record presented in a recognition procedure. The method has also been used with the experimenter participating as the subject (e.g., Linton, 1975; White, 1982; Wagenaar, 1986). See Abel (1947), and Reason and Lucas (1984) for a discussion of the method.

Study	General Focus of Study
Barclay & Wellman (1986)	Event dating, organization of autobiographical memory
Bruce & Van Pelt (1989)	Frequency, spatial and temporal (date) aspects of autobiographical event memory
Crovitz, Cordoni, Daniel & Perlman (1984)	Forgetting everyday experiences
Linton (1975), also see Linton (1978, 1979, 1982)	Event dating strategies and accuracy

Thompson (1982)	Event dating strategies, effects of event memory, rehearsal, actor/observer differences
Thompson (1985a)	Event dating, relationship of 'affect' to recall and dating accuracy
Thompson (1985b)	Event dating, effect of event memory and involvement in event
Thompson, Showronski & Lee (1988)	Event dating, organization of autobiographical memory
Wagenaar (1986)	Event dating accuracy, retrieval of autobiographical memories, organization of autobiographical memory
White (1982), also see White (1989)	Event dating accuracy, retrieval of autobiographical memories

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Section 2: Prompted Free-Association Recall of Autobiographical Memories

Originally developed by Galton (1879), this method involves presenting a subject with a word (e.g., "boat", Cermack & O'Connor, 1983) which they use in a free-association manner as a prompt to recall a specific autobiographical memory. Crovitz and Schiffman (1974) are generally credited with the revival of Galton's word association technique (Rubin, 1986), and it is currently the most popular method of studying autobiographical memory (Brewer, 1986). Sometimes activity descriptions (e.g., "visiting a doctor", Reiser, Black & Kalamarides, 1986) are used as prompts rather than single words.

Study	General Focus of Study
Cermak & O'Connor (1983) Experiment 2	Memory impairment from amnesia due to encephalitis
Crovitz & Quina-Holland (1976)	Proportion of autobiographical memories recalled from early childhood as a function of age of memory
Crovitz & Schiffman (1974)	Frequency of autobiographical memories recalled as a function of age of memory
Fitzgerald (1981)	Frequency of autobiographical memories recalled as a function of age of memory
Fitzgerald (1980)	Sampling of autobiographical memory
Fitzgerald & Lawrence (1984)	Autobiographical memory across the life-span
Franklin & Holding (1977)	Memory retrieval speed, age distribution of recalled memories
Galton (1879)	Contents of memory
Holding, Noonan, Pfau & Holding (1986)	Memory retrieval speed, age distribution of recalled memories
McCormack (1979)	Frequency of autobiographical memories recalled as a function of age of memory

Reiser, Black & Abelson (1985)	Organization and retrieval of autobiographical memory
Reiser, Black & Kalamarides (1986)	Autobiographical memory search processes
Robinson (1986)	Event dating reliability
Robinson (1980)	Affect and the retrieval of autobiographical memories
Robinson (1976)	Event dating reliability, sampling autobiographical memory, effect of cue word type, age of memory and type of experience
Rubin (1982)	Event dating reliability, autobiographical memory recall as a function of time since event
Sagar, Cohen, Corkin & Growdon (1985)	Recall of autobiographical memory, effect of Alzheimer's, Parkinson's and long-standing focal brain trauma
Uhlenhuth, Haberman, Balter & Lipman (1977)	Recall and age distribution of various types of autobiographical events
Warren, Chatlin, Thompson & Tomsky (1983)	Effect of autobiographical elaboration on noun recall
Warren, Hughes & Tobias (1985)	Effect of autobiographical elaboration on memory for adjectives

Williams & Broadbent (1986)	Bias in autobiographical memory retrieval in suicide attempters
Zola-Morgan, Cohen & Squire (1983)	Recall of autobiographical memories by amnesic, Korsakoff's and ECT patients

Section 3: Un-prompted Recall of Autobiographical Memories

Subjects are simply asked to recall and describe autobiographical events. No prompts or cues to recall are provided, although sometimes limits are placed on recall, such as "please describe a memory that you have of your freshman year in college" (Pillemer, Rhinehart & White, 1988, p. 711).

Study	General Focus of Study
Bond & Brockett (1987)	Memory for acquaintances
Fuhrman & Wyer (1988)	Temporal-order of autobiographical memories
Harvey, Flanary & Morgan (1986)	Flashbulb memories, vividness of associated memories
King & Pontious (1969)	Retrieval-order effects in autobiographical memory
Pillemer, Goldsmith, Panter & White (1988)	Memories of first year of college, distribution of memories within this year
Pillemer, Koff, Rhinehart & Rierdan (1987)	Recount memories of menarche - flashbulb memories

Pillemer, Rhinehart & White (1986)	Autobiographical memories and periods of life transition
Reynolds & Takooshian (1988)	Efficiency of date information as a prompt to recall
Riegel (1973)	Lifespan development
Rubin & Kozin (1984) Experiment 1, Part a	Flashbulb memories
Smith (1952)	Accuracy of autobiographical memory recall
Waldfogel (1948)	Proportion of autobiographical memories recalled from early childhood as a function of age of memory
Whitten & Leonard (1981)	Retrieval-order effects in autobiographical memory

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Section 4: Use of Archival Records

The experimenter obtains information on events an individual has experienced. The recording of the information is sometimes a phase of the experiment, although generally it is routinely performed as part of the event (e.g., an individual's attendance at an exam). Sometimes information on the circumstances surrounding the experience of an event is used (e.g., recall is of the features of the environment in which the event occurred). Generally the obtained event information is used in a similar way to that obtained with the diary method.

Study and Type of Archival Record	General Focus of Study
Baddeley & Hitch (1977). Rugby club records	Effect of recency on recall
Baddeley, Lewis & Nimmo-Smith (1978). Attendance at an applied psychology laboratory	Event dating, recall strategies and ability to recall autobiographical event information
Bahrick (1979). Names and location of streets in the city subject attended university	City knowledge, recall and recognition
Bahrick, Bahrick & Wittlinger (1975). Names and photographs taken from high school year book	Recall and recognition of names and faces - effects of retention interval
Beatty & Spangenberger (1988). Geographical features of the region in which the subject was born	Persistence of geographical memory
Douglas & Blomfield (1956). Records from a study of maternity services and the cost of child-bearing	Reliability of retrospective recall
Field (1981). Records from a longitudinal study of development	Reliability of retrospective reports/autobiographical memory
Gold & Neisser (1980) Kindergarten records	Early memories - recollections of kindergarten
Janis (1950). Records from an interview	Autobiographical memory impairment after ECT treatment

Jojce, Caple, Maron, Reynolds & Mathews (1969). Doctors records of consultation	Effect of retention interval on recall of doctor/patient consultation
Levin, High, Meyers, Von Laufen, Hayden & Eiskenberg (1985) Experiment 2. Information obtained from a relative	Autobiographical memory impairment after closed head injury
Ley, Bradshaw, Eaves & Walter (1973). Doctors records of consultation	Methods of increasing the recall of doctors advice
Ley & Spelman (1965). Doctors records of consultation	Recall of doctor/patient communication
Ley, Whitworth, Skilbeck, Woodwarward, Pinsent, Pike, Clarkson & Clark (1976). Doctors records of consultation	Improving patient memory for medical advice
Loftus & Fathi (1985). Psychology course examination records	Effects of retrieval order - backward and forward search - on autobiographical memory recall
Mednick & Shaffer (1963). Medical records	Reliability of retrospective recall
Neisser (1981). Conversation transcripts	Accuracy of autobiographical memory
Pyles, Stolz & MacFarlane (1935). Medical records	Reliability of retrospective recall
Speakman (1954). British postage stamps	Recall of stamp value - age/memory relationship

Yarrow, Campbell & Burton (1970). Records from longitudinal study	Reliability of retrospective recall
Zola-Morgan & Oberg (1980). Records from a field trip	Autobiographical memory impairment in an alcoholic Korsakoff patient

Section 5: Public Events

Significant public events (e.g., the explosion of the space shuttle Challenger; Bohannon, 1988) have been used in a variety of ways in memory research: subjects have been required to recall or recognize information associated with the event itself (e.g., Albert, Butters & Levin, 1979; Botwinick & Storandt, 1974; Cermak & O'Connor, 1983; Johnson & Klinger, 1976; Perlmutter, 1978; Sanders & Warrington, 1971; Seltzer & Benson, 1974; Shimamura & Squire, 1986; Squire, 1974; Storandt, Grant & Gordon, 1978; Warrington & Sanders, 1971; Warrington & Silberstein, 1970), to recall the date on which the event occurred (see Chapter 1, Section 1.3 to 1.3.4), and to recall information relating to the circumstances of hearing about the event. However, only in the latter case where memory for the personal event of hearing about the public event is investigated, is the research focusing on autobiographical memory. The term 'flashbulb memories' (Brown & Kulik, 1977) is generally used to specifically define the aspect of autobiographical memory being studied. In accordance with the above discussion, and the focus of this chapter, only studies which have used public events to investigate autobiographical memory are listed in this section.

Study and Public Event Used	**General Focus of Study**
Bohannon (1988). Explosion of the space shuttle Challenger	Variables effecting flashbulb memories - emotion, rehearsal, retention interval

Brown & Kulik (1977). Assassination of J. K. Kennedy	Flashbulb memories
Christianson, Carlsson, Fredriksson, Nilsson & Viktorsson (1988). Assassination of Olf Palme	Reliability of flashbulb memories
Colegrove (1899). Assassination of President Lincoln	Recall of autobiographical events associated with a public event
Pillemer (1984). Assassination attempt on President Reagan	Variables effecting flashbulb memories - rehearsal, emotion
Rubin & Kozin (1984). Experiment 1, Part b. Used a number of events e.g., The night President Nixon resigned	Variables effecting flashbulb memories - surprise, importance
Winograd & Killinger (1983). Assassination of J. F. Kennedy	Development of flashbulb memories
Yarmey & Bull (1978). Assassination of President J. F. Kennedy	Nature of flashbulb memories

3.2 Diaries and Their History

It is not easy to define the term 'diary'. The definition given in The Pocket Oxford Dictionary; "Daily record kept of events or thoughts" (Fowler & Fowler 1975, p. 229) is too precise. Many individuals who keep a diary do so only intermittently. Furthermore, 'events or thoughts' falls short of an adequate description of the material entered in diaries. A description of the frequency and nature of diary entries must be very general if it is to account for the enormous individual differences between diarists. Perhaps the only precise statement that can be used to describe a 'diary' is that it is written in the

first person, and contains a more or less continuous series of "responses to the writer's present situation and recent experience" (Fothergill, 1974, p. 48). However, diaries as a form of personal document vary so much that perhaps the only definition which applies to them all is ". . . a diary is what a person writes when he (or she) says, 'I am writing my diary" (Fothergill, 1974, p. 3).

Diary keeping as a separate literary activity developed from a number of pre-diary habits. Four literary forms are identified by Fothergill (1974) as the ancestors of diary-keeping: journals of travel, conscience, personal memoranda, and 'public' journals. Although each type of journal is classed as a separate literary form, and each serves a distinct function, all four contain, to some extent, descriptions of an individual's and others' actions, experiences and beliefs.

Travel journals were kept by gentlemen when 'abroad'. Francis Bacon, in his essay, *'Of Travel'* (1906) details the use of such a journal on a gentleman's travels. This literary form has to some extent survived intact, travel diaries are available from stationists and 'travel' is still sufficient to prompt some individuals to keep a record of their experiences (see the discussion of motives behind diary-keeping in Section 3.3.1.5).

Religious belief was largely responsible for journals of conscience. These journals contain largely expressions of thoughts, feelings, and opinions, and were used for self-development. Quakers often used such journals for religious disciplinary purposes (Ponsonby, 1974). The type of material one should record in a 'journal of conscience' and the spiritual benefits which might result from such a habit are described in John Beadle's *The Journal or Diary of a Thankful Christian* , published in 1656.

Fothergill's other two classes of journal, 'journals of personal memoranda' and 'public journals' were both used to intermittently record the 'events of the day', but in contrast to the 'journal of travel' were not prompted by the nature of one's activities. The former often consisted of a number of notes or jottings relating events in the life of the author or those around him. Public journals, on the other hand, were kept in a more formal manner and contained such things as transactions of public bodies and details of military campaigns.

From Fothergill's four literary forms, or types of journals, developed the habit of diary-keeping. Beginning in the sixteenth century, a few well-educated people began to keep daily records of the events in their lives and those around them, and their thoughts, feelings and opinions. The practise was predominantly undertaken by well-educated men (Ponsonby, 1974). Education was undoubtedly a prerequisite for keeping a diary, ensuring literacy and allowing the diarist to express himself well in writing. At this time in history the well educated were normally wealthy, thus possessing the means to buy the necessary materials for diary-keeping.

It is interesting that, in the past, diarists seem to have been mainly male (Aitken, 1944; Dunaway & Evans, 1957; Fothergill, 1974; Forbes, 1923; O'Brien, 1944; Ponsonby, 1923, 1927; Ponsonby, 1974). It is possible, however, that the records we now have, which are mainly published diaries and those held by museums, are not a representative sample and that many females kept diaries during the sixteenth, seventeenth and eighteenth centuries. Indeed, by the nineteenth century, diary keeping had become quite fashionable among ladies (Ponsonby, 1974), while surveys of diary-keeping conducted this century have consistently found more female than male diarists. (These surveys are discussed in detail in Section 3.3). Perhaps, then, the single most significant development in the history of diary-keeping is that a once predominantly male behaviour is now practised predominantly by women.

Diary keeping is also no longer confined to the wealthy and educated, although a certain level of literacy is required. The materials required for diary keeping, pencil and paper, are now generally available. Indeed, this is also an important aspect in the history of diary keeping. Not only are the necessary materials now readily available, but the 'diary' has been developed as a 'retailable' item, commonly available in stationary shops.

It would be inappropriate to discuss the history of diary keeping in more detail in this thesis. The interested reader is referred to Fothergill (1974) and Ponsonby (1974). However, as a human behaviour diary keeping is particularly intriguing. As to what motivated many individuals to begin recording daily experiences, thoughts and feelings during the nineteenth century, there is no obvious answer.

3.2.1 The History of Diaries in Scientific Research

Personal documents, including diaries, have been used by psychologists, psychiatrists, sociologists, anthropologists, historians and autobiographers. Anthropologists, historians and autobiographers use personal documents as a source of fact and opinion. The documents are used in an objective way, as a source of information. The advantages and disadvantages of using this material in historical and anthropological research have been discussed by a number of authors (e.g., Freidel, 1955; Gottschalk, Kluckhohn & Angell, 1945; Ponsonby, 1923). Psychologists, psychiatrists and sociologists, on the other hand, have tended to 'reason' from the contents of personal documents in relation to the phenomenon being investigated. The use of personal documents in this kind of inductive research has also been extensively discussed (e.g., Allport, 1942; Angell & Freedman, 1953; Gottschalk et al., 1945; Madge, 1965; Plummer, 1983).

Psychologists, psychiatrists and sociologists began to use personal documents as research 'tools' towards the end of the nineteenth century. Diaries, in particular, were used extensively, being considered "the personal document *par excellence.*" (Allport, 1942, p. 95). Researchers generally worked with a single 'diary' or subject, two or three at most. The diary material was either solicited from students or obtained from an established collection, for example 'The Vienna Collection' (Allport, 1942) (The details of a number of extensive collections of diary material can be found in Iovetz-Tereschenko (1936)). Researchers simply performed a type of qualitative analysis on the material. Excerpts from the diaries were published together with interpretations and discussions of their meaning in relation to the phenomenon being investigated. These often formed the bases of hypotheses and theories.

This method of inductive reasoning from diary records has been employed to study religious experience (e.g., Clark, 1929; James, 1901-2; Kupky, 1928; Starbuck, 1899), adolescent love and relationships (e.g., Hall, 1904; Iovetz-Tereschenko, 1936; Runner, 1937), family disorganization (Mowrer, 1927), the social meaning of suicide (Cavan, 1928; Douglas, 1967), the experience of aging (Berman, 1986; Drakeford, 1984) and language development (Fuchs, 1927). Around the turn of the century then, the use of diaries in research was reasonably wide-spread. However, early in the

twentieth century the number of studies employing such documents declined rapidly, particularly in psychology (Allport, 1942). The use of personal documents in sociological research, although also declining about this time, continued to be reasonably popular.

Psychology as a science radically changed during the early part of the twentieth century, and some authors (e.g., Allport, 1942; Madge, 1965) have attributed the decline in the use of personal documents in psychological research to this change in psychology as a whole. Traditionally psychology was based on the introspective conclusions of individual philosopher-psychologists. During the early part of the twentieth century the value of a science based on dogmatic phenomenology began to be questioned. The inadequacies of introspection were pointed out by the behaviourist school of psychology, overt behaviour became the subject matter of psychology, and many laboratories were established. Personal documents were seen as 'subjective material' (Allport, 1942), and the way they were used in research as out of line with the prevailing scientific temper. This demand for objectivity in psychology probably reduced the use of personal documents in research. However, analysis of personal documents as a method never completely disappeared, perhaps it continued as " . . . a protest against the laboratory emphasis and against the aridity of behaviourism" (Allport, 1942, p. 127), and not because of the value of the method.

Personal documents probably were rejected as useful 'tools' for scientific research primarily because of the way in which they had been used. Psychology was striving to become a more 'objective' science and still is in many areas. There has, however, recently been a trend within psychology towards the reacceptance of phenomenal data in experimental psychology (see Ericsson & Simon, 1980; Hilgard, 1980, and Natsoulas, 1970 for discussions of this issue). Furthermore, Taylor, Robinson and McCormick (1986) have argued that the examination of personal documents should be restored as a technique in the study of personality, as long as the documents are submitted to sensitive, reflective and expert analysis. It is perhaps ironic that diaries are used in this thesis in order to increase the objectivity and validity of autobiographical memory research.

3.3 Diarists, Diary Keeping and Diary Material

Who are diarists? This is a critical question in relation to the validity of generalizations that a researcher using diaries might make. Are diarists representative of the population about which a researcher might enquire? Research using diaries has been criticized on this point;

> " . . . no one seems to have ascertained what proportion of adolescents in various countries and in various socio-economic groups keep diaries. Diaries which are used to support a number of generalizations regarding adolescence seem to us to be worth but little unless there is some way of telling to what extent the adolescents who keep diaries are representative of those who do not - the latter must surely be the vast majority". (Murphy, Murphy & Newcomb, 1937, p. 841)

Some authors have, however, suggested diarists possess no special or definable attributes. For example,

> " . . . there is nothing in age, sex, character, profession, religion or circumstances which can be taken as a safe indication of whether a man or woman is a diarist or not" (Ponsonby, 1974, p. 10).

Ponsonby's statement is, at best, a gross over-simplification, and is not based on any empirical evidence. Moreover, in the past, as we have seen, sex, religion, and circumstances (e.g., education) have been influential in determining who became a diarist.

There have been remarkably few studies conducted on the characteristics of diarists, especially contemporary diarists, and, unfortunately, very few details have been obtained from those studies which have been conducted. Ponsonby (1923) found that 41 percent of the males and 61 percent of the females of a random sample of educated people over 30 years of age had been or were diarists. A Russian study by Uher (1935, cited in Allport, 1942) found one third of the adolescent males and two thirds of the adolescent females sampled kept diaries. A study of 3500 Japanese students with an age range of 13 to 21 years was conducted by Yoda in 1938. Half of the college students and a smaller percentage of middle-graders were found to be diarists (cited in Allport, 1942).

Finally, Allport (1942) reported that an unpublished study conducted in North America found 71 percent of the female students sampled had kept a diary, with 36 percent still doing so. The above studies were conducted some time ago; some more up-to-date information is given by Rubin (1982, Experiment 5). As part of an experiment on the reliability of event dating Rubin asked 394 introductory psychology students if they kept a diary, and if so, over what period. Two hundred and thirteen subjects responded positively. No data on the length of records of the majority of this group was reported, however, the 9 subjects (diary keepers) chosen as research participants had kept an average of 6 years of records with a range of 3 to 10 years. No other data were reported.

It is difficult, and perhaps unwise, to draw anything other than tentative conclusions from these studies. It appears that more females than males keep diaries and that diary keeping is not confined to English speaking cultures. Finally, the proportion of individuals in each study that had been or were diarists is quite large. This may, however, be an artifact of the age range sampled; Iovetz-Tereschenko (1936) has suggested that the keeping of diaries is particularly prominent during adolescence.

The following questionnaire survey (Experiment 5) was motivated by both the wish to obtain more recent data on diary keeping and as part of research into autobiographical event memory.

3.3.1 Experiment 5: A Questionnaire Survey Of Diarists

3.3.1.1 Method

Questionnaire

The questionnaire contained three sections: a general information section containing questions on the subjects' sex, age, ethnic group and marital status (a question on education was also included in the questionnaire completed by the community sample); a diary-keeping section with eleven questions specific to diary-keeping (shown in Figure 3.1); and a section requesting research participants for Experiment 6. Subject instructions were printed on the cover page. The questionnaire was entitled 'The Diary-Keeping Prevalence Study'.

Figure 3.1. Questions on diary-keeping from the diary-keeping prevalence study questionnaire.

Diary-Keeping Section

(6) Do you keep or have you ever kept a diary?

No ( ) If no do not continue
Yes ( ) If yes please continue

(7) At what age or between what ages have you kept a diary?

Age..... or From.....to.....

(8) Please indicate which category(ies) below best describes the nature of your diary entries (Tick as many categories as necessary)

Salient life events	( )
Everyday life events	( )
Personal thoughts and feelings	( )
World events	( )
Events that have occurred in other peoples lives	( )
Other (please specify)	( )

(9) Please indicate at what time of the day you generally write/wrote in your diary

In the morning	( )
Midday	( )
In the afternoon	( )
In the evening	( )

(10) Do/did you write in your diary every day?

Yes	( )
No	( )
Almost every day	( )

(11) If you forgot or can/could not write in your diary for some reason on a particular day do/did you:

Leave that page blank? ( )
Make an entry at some later date? ( )

(12) Have you ever fabricated events in your diary so as to avoid the true nature of your activities being discovered e.g., by your parents?

Never.....|.....|.....|.....|.....|.....|.....Frequently
1 2 3 4 5 6 7

(13) Do/did you use codes in your diary? That is, do/did you record things using symbols or letter sequences etc that only you know the meaning of.

Never.....|.....|.....|.....|.....|.....|.....Frequently
1 2 3 4 5 6 7

(14) Have you retained your diaries?

Yes (all of them) ( )
Yes (some of them) ( )
The diary I am writing in currently is
my first diary but I intend to retain it ( )
No ( )

(15) Do/did you read back over your diary entries?

Never.....|.....|.....|.....|.....|.....|.....Frequently
1 2 3 4 5 6 7

(16) In your own words please describe why you keep or once kept a diary.....
.....

Subjects

One hundred and seventy-one males with an age range from 16 to 36 (mean 19.6 years) and 307 females with an age range of 17 to 59 (mean 20.7 years) from the Stage 1 psychology course at the University of Canterbury completed the questionnaire.

Two hundred and twenty-three questionnaires were also distributed to Stage 2 psychology students at the University of Canterbury. These students were required to interview a member of the community as part of a 'life-history' assignment, and administered the diary-keeping questionnaire at the same time. Thirty-one of these questionnaires were returned, of these 20 had been completed by males ranging in age from 26 to 88 and 11 by females with an age range of 43 to 91 years.

Procedure

The student sample completed the questionnaire in groups during March 1987. Instructions printed on the cover page of the questionnaire were read out. Completion of the questionnaire required approximately ten minutes.

The community sample completed the questionnaire during the course of their 'life history' interview in August 1987. They were instructed to read the instructions printed on the cover page carefully before beginning.

The student and community samples were not combined for analysis purposes. Generally only the student sample's data are discussed; however, where appropriate, data from the community sample are presented.

3.3.1.2 Results and Discussion

3.3.1.3 Prevalence and Demographic Factors

Of the 478 student respondents that completed the questionnaire, 36 males and 158 females had once kept a diary, and 19 males and 65 females were keeping one at the time of the study. Thus 55 or 32 percent of the males and 223 or 72 percent of females sampled had been or were diarists. These results

are consistent with the studies reported earlier in terms of the sex difference, with more females than males being diarists. Diary keeping also appears to be quite common, with over 58 percent of the sample defined as diarists. Plummer's (1983) statement that " . . . the diary as a form of writing seems to be going out of fashion" (p. 18) appears to be incorrect, at least for this sample. Furthermore, the apparent prevalence of diary-keeping is not consistent with the statement made by Murphy et al. (1937) quoted earlier. It is also possible that diary-keeping is even more prevalent than the above results indicate. Diary-keeping is a rather private and sometimes secret behaviour and because of this " . . . anyone making enquiries about diary-keeping may quite well be met with a denial from a habitual diarist" (Ponsonby, 1923, p. 3).

The sex difference in diary-keeping is not a problem for researchers contemplating using diaries. A reasonable number of men do keep diaries. A researcher should, therefore, be able to obtain a suitable sample of both males and females without too much effort (see Chapter 4, Section 4.1.1 for the results of the administration of the 'research participant request form'). Furthermore, the finding that the majority of the sample could be categorized as 'diarists' suggests that diarists are not a small special subgroup of individuals.

It is possible, however, that the prevalence figures obtained from this survey do not apply to the general population. The sample, university students, can be described as 'reasonably well educated'. Furthermore, when the effect of education on diary-keeping was examined in the 'community' sample a significant result was obtained (F (1, 30) = 8.158, p < . 0.05). The mean number of years of secondary and tertiary education of the diary-keepers in the sample (N=17) was 6.9, while that of the non-diary-keepers (N=14) was 3.5. Therefore, diary-keeping may well remain chiefly the domain of the educated.

The size of specific ethnic groups within the student sample (New Zealand Maoris, Asians or Pacific Islanders) was unfortunately very small. However, <u>all</u> of the females (N=8) and 36 percent of the males (N=14) in these three ethnic groups were diarists. These results suggest that diary-keeping may be prevalent in different ethnic groups and that it may be possible to conduct cross-cultural studies in autobiographical memory using diaries.

Interpretation of the marital status results is rather difficult because of the nature of the student sample: only seven percent of the sample were married. Fifty-five percent of the married respondents were, however, keeping a diary at the time of the survey. Diary-keeping is, therefore, not solely a behaviour of single individuals.

The 'age' data must also be interpreted with caution. The youngest age at which both a male and female respondent indicated he or she had kept a diary was seven, while data from the community sample indicated that some individuals (N=3) were doing so when over 70 years old. The majority of the student sample male diarists indulged in the behaviour between 17 and 18 years of age, while for the females the peak was slightly earlier, between 15 and 16 years of age. The latter results perhaps reflect the age distribution of the sample. However, the 'peaks' in diary-keeping for each sex are slightly earlier than the mean sample ages. There is, therefore, some support for Iovetz-Tereschenko's (1936) suggestion that diary-keeping is particularly prominent during adolescence.

3.3.1.4 Diary Keeping Characteristics: Duration

At the time of the survey the male diarists had kept diary records for a mean of 2.6 years and the female diarists for a mean of 3.8 years. It is, however, possible that the mean difference reflects the overall age difference between the males and females sampled: the females on average were approximately one year older than the males. It should also be noted that there is no guarantee that, for example, a respondent who indicated she or he kept a diary at age 17 kept it for the <u>whole</u> year. On the other hand, it is important to remember that a considerable number of the diarists may go on to compile many more years of records. Seven diarists from the community sample had kept a diary for over 30 years, with 67 years being the maximum duration indicated.

The 278 student diarists surveyed had in total recorded approximately 990 years of diary records. Presumably entries were not made on all of the 361,350 days. Nevertheless, the amount of material recorded is quite staggering. The potential this material has for research, however, can only be realized if diarists retain it. Eighty percent of the female and 62 percent of the male diarists indicated they had, or planned to, retain some or all of their

diary records. Thus, while some diary records are lost or destroyed, the amount of potentially usable material is enormous.

3.3.1.5 Motives

That some diary material is either lost or destroyed may indicate that for some individuals, their completed diaries have little or no value. This raises the question: Why do individuals keep diaries at all? The student samples brief descriptions of why they had kept or were keeping a diary were divided into 11 reasons by the experimenter. Table 3.2 shows the 11 reasons, (ranked according to the frequency of use) and the percentage of male and female diarists giving each reason. Nineteen males and 84 females gave more than one reason for keeping a diary which is why the percentages shown in Table 3.2 do not add to 100.

Inspection of Table 3.2 indicates that most diarists, both male and female, kept a diary as an aid to the future recall of past events (e.g., reason 1). Ponsonby (1923) noted that this was one motive for diary-keeping, and the value of diary records as a memory 'trigger' was mentioned by Peeples (1957). The table also shows diaries are used as a day-to-day memory aid (e.g., reason 6). Harris (1978), in a study of 'memory aids', reported 93 percent of the 30 students questioned used a diary as a prospective memory aid. Generally, the between-sexes tests for proportional differences did not produce any meaningful results. However, there may be a sex difference in using a diary as a 'confidant' (e.g., reason 8) as only female subjects gave this reason. Furthermore, when the proportion of diarists that kept a diary as a confidant, emotional outlet, and a place to sort things out (e.g., reasons 2, 4 and 8) were combined and compared between the sexes a significant ($p < 0.05$) difference was obtained $Z = 2.510$ (critical $Z = 1.960$). Overall a significantly greater proportion of the female diarists kept a diary for these 'subjective' reasons.

Some diarists obviously see their diary records as having some value in the future (e.g., reason 1), and one might expect these individuals to retain their diaries. On the other hand, the diarists that used a diary as a confidant, emotional outlet or a place to sort things out (e.g., reasons 2, 4 and 8), rather than keeping a diary for its value in the future, see it as fulfilling its function at the time that entries are made, and one might expect these individuals would be less concerned with the future whereabouts of their diary records. These

diarists may even destroy their diaries, as their motive for keeping them suggests they may contain sensitive, potentially damaging material. However, the proportion of diarists (18.5 percent) that had kept a diary as a confidant, emotional outlet, and a place to sort things out (e.g., reasons 2, 4 and 8) and no longer had their diary records was essentially the same as the proportion (18.1 percent) that kept a diary for its value in the future (e.g., reason 1) and that had indicated they no longer had their diary records.

Reason For Keeping A Diary	Percentage of Males	Percentage of Females	Test of Proportional Difference
(1) The records would help the individual to remember life events at some later date. They would provide a source of cues for reminiscence	38.1	39.0	Z=0.12
(2). A place to record thoughts and feelings towards life events, an emotional outlet	21.8	29.1	Z=1.09
(3) Simply wished to record their life events	12.7	19.2	Z=1.150
(4) A place to clarify thoughts and ideas, sort out problems	7.2	14.7	Z=1.51
(5) Record travel experiences	12.7	9.4	Z= 0.73
(6) To plan for the future, work schedules, appointments, birthdays and other important dates	10.9	8.0	Z=0.71
(7) The diary was given as a present and they felt obliged to use it	16.3	6.2	Z=2.47 *
(8) The diary was / is a confidant, a friend to discuss ones life with	0	9.4	_
(9) Because others / friends kept a diary.	3.6	4.9	Z=0.44
(10) To improve writing ability	0	.8	_
(11) So as to provide a record of their life for their family when they die	0	.4	_

Note - Two tailed test of proportional differences * = 0.05 (critical Z=1.960), **= 0.01 (critical Z = 2.576)

Table 3.2. Reasons given for keeping a diary and the percentage of male and female respondents that gave each reason.

Terms which have been used to describe diarists, such as egotistical, vain, self-absorbed and self-conscious (Ponsonby, 1923), although unsubstantiated, are likely to apply, if at all, to those diarists that kept diary records for more subjective reasons. However, in the final analysis, the large proportion of the sample defined as diarists, itself indicates diary-keeping to be a normal activity, not one restricted to an egotistical subgroup. For further discussion of the motives behind diary-keeping see Allport (1942) and Fothergill (1974).

3.3.1.6 Memory Effects

Perhaps the most important question in relation to the use of diaries in autobiographical memory research is whether the act of recording an event in a diary makes it more memorable. Describing an event in a diary is essentially the rehearsal of the individual's memory of the event. The results of the present study do not supply any information which can be used to answer this question directly. This question has, however, been investigated in studies where the experimenter has recorded his own autobiographical events (Wagenaar, 1986) or instructed others to do so (Thompson, 1982). In neither study was a significant effect of event recording on memorability found. In these studies the recorder also knew that he or she would be required to recall the events, which was not the case for the diarists that participated in Experiment 6 of this study. On the basis of these results one might expect that describing an event in a diary does not significantly affect its memorability.

Recording an event also makes it available for rehearsal; it can be rehearsed at any time by simply reading the entry. Figure 3.2 shows the percentage of male and female respondents in the student sample who gave each rating for how frequently they read back over their diary entries. A very large proportion, 98.9 percent of the diarists sampled, did read back over their diary entries at some time, some more frequently than others. However, the wording of the question may have biased these results. Respondents may have interpreted it as meaning do they read back over their diary entries immediately after making them. Few individuals write something down and do not read over it. It is impossible from these results to determine how long after an entry was made that it was read.

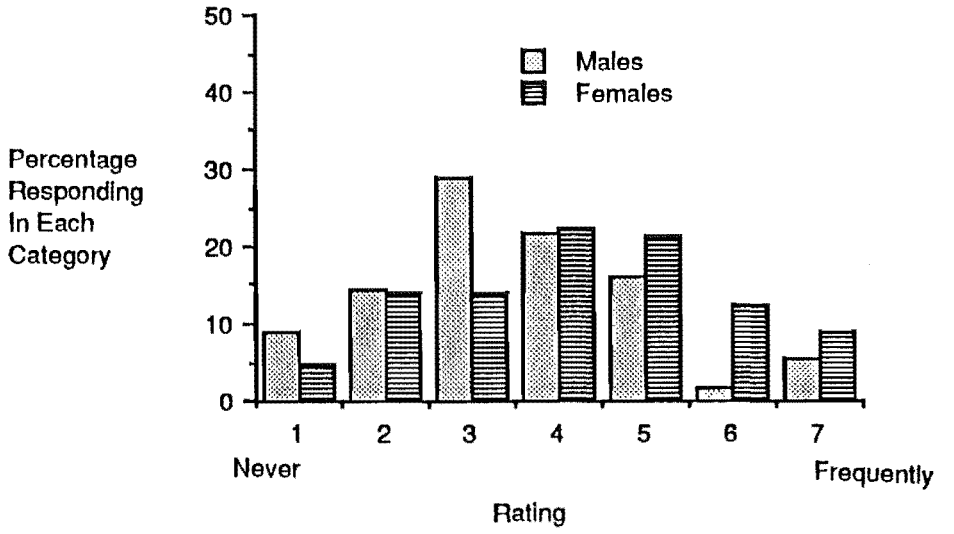

Figure 3.2. The percentage of male and female respondents giving each rating for how frequently they read back over their diary entries.

The male and female respondents' frequency ratings, shown in Figure 3.2, were found to be significantly different (F (1, 277) = 7.203, $p < 0.01$); with the female diarists giving a higher mean rating (4.15) than the male diarists (3.50). This result perhaps reflects the sex difference in relation to the 'subjective' use of diaries; more females kept a diary for subjective reasons and subjective entries might be more prone to review.

3.3.1.7 Diary Entries

The character of diary entries has implications for the type of research which diaries can be used for, and the generalizations that can be made. Are the activities, thoughts and feelings described in diaries representative? Experiment 6 used diary entries to investigate subjects' memory of autobiographical events. Only those diary entries that were objective, factual accounts of events were used in the experiment, and then only when all the required information was recorded. Subjective entries, that is descriptions of feeling, opinions and motives, were not used in this research but might be useful for other research dealing with such aspects of biographical memory.

The characteristics of diary entries have been described by Allport (1942), Fothergill (1974) and Ponsonby (1923), based on extensive reading of published

diaries and those held in museums. Although the diaries read by Allport, Fothergill and Ponsonby were generally compiled many years ago by 'famous' individuals, some of the statements they make regarding the character of diary entries are still relevant today. Indeed I found very similar types of entries in my readings of contemporary diaries of relatively unknown individuals.

Diary entries vary both in terms of the material recorded and the style used. Some diarists simply note the day's occurrences in an objective way, while others used complete, crafted sentences to detail their thoughts and feelings, as well as the day's events (Fothergill, 1974; Ponsonby, 1923). Although the nature of the material recorded and the style of recording varies greatly between diarists, within a single diary such factors usually remain fairly constant (Fothergill, 1974). One thing that can be said about most, and probably all diary entries, is that they only relate a sample of the day's activities, thoughts and feelings. Diarists do not generally record the day's events in 'script' form noting everything about their day from 'rising' to 'retiring'.

To try and systematically describe exactly what a diarist might record would be absurd: entries are as varied as the activities which humans indulge in. Respondents were, however, asked which of five categories (plus an 'other' category) best described their diary entries. Respondents could specify more than one category (which is responsible for why the percentages shown in Table 3.3 do not add to 100). Table 3.3 shows the percentage of male and female diarists in the student sample that specified each category. The percentage of males and females that indicated they made more than one type of entry (e.g., they made entries about both 'salient life events' and 'personal thoughts and feelings') are also shown in Table 3.3 for the four category combinations primarily used by the respondents. It appears that diary entries are either predominantly 'objective', detailing the activities of the diarist during the day, or subjective, dwelling on the individual's thoughts and feelings during the day. Tests of proportional differences within the entry categories indicate that the female diarists made significantly more 'subjective' entries than the males. These results are consistent with those reported earlier on the motives for diary keeping: diaries being primarily kept as either an aid to the future recall of past events or as a confident, emotional outlet and a place to sort things out, with the sex difference between motives being similar to that found for the types of diary entries made. The data on diary entries also calls into question the validity of Murphy et al.'s (1937) statement that;

"There are, to be sure, a few diaries of matter-of-fact youngsters who simply tell what they had to eat and whether they went to the movies or went roller skating but they are few." (p. 841)

Type of Diary Entry	Percentage of Males	Percentage of Females	Test of Proportional Difference
Everyday life events	65.4	73.9	Z=1.25
Personal thoughts and feelings	52.7	74.8	Z=3.20 **
Salient life events	43.6	30.0	Z=1.93
Events that have occurred in others lives	20.0	24.2	Z=0.66
World events	9.0	9.4	Z=0.09
Other - Entries specified "poetry' & 'ideas"	0	.8	-
Category Combinations			
Everyday life events and personal thoughts and feelings	29.0	51.1	Z=2.94 **
Salient life events and personal thoughts and feelings	23.6	24.2	Z=0.09
Salient and everyday life events	20.0	18.8	Z=0.20
Salient and everyday life events and personal thoughts and feelings	10.9	14.7	Z=0.72

Note - Two tailed test of proportional difference * = O.05 (critical Z=1.960), ** 0.01 (critical Z=2.576)

Table 3.3. Types of material recorded in diaries and the percentage of male and female respondents that recorded each type of material.

As already mentioned, not only does the type of entry made vary between diarists but also the level of description given: some diaries contain more detail than others. Diarists

" . . . are liable to take much for granted often failing to describe persons or situations whose existence and character the diarist merely assumes." (Allport, 1942, p. 98)

This is unsurprising as the diarist is not describing the day's occurrences for the information of others. The omission of details relating to events has implications for the research potential of such material. Where complete event information is required, for example, the 'what', 'where', 'who' and

'when' of an event, a considerable amount of diary material may need to be read for a suitable sample of events to be obtained.

If the researcher requires information on a specific type of event, the task of locating it could be even more difficult if some diary entries are made in 'code' form. Ponsonby (1923) discussed the use of 'codes' in diary entries, noting

> "Various devices are used by diarists to ensure secrecy. Many seem to fear the accidental discovery of their volume. Cypher is by no means uncommon for special entries." (p. 25)

Codes were encountered in a number of the diaries examined in Experiment 6. One can only speculate as to the nature of activities entered in code form. It is most probable that they are sexual activities, although uncoded descriptions of sexual activities are not uncommon.

Almost half of the student diarists surveyed, 46.7 percent, indicated they had at some time made a 'coded' entry in their diary; of these, 16.1 percent

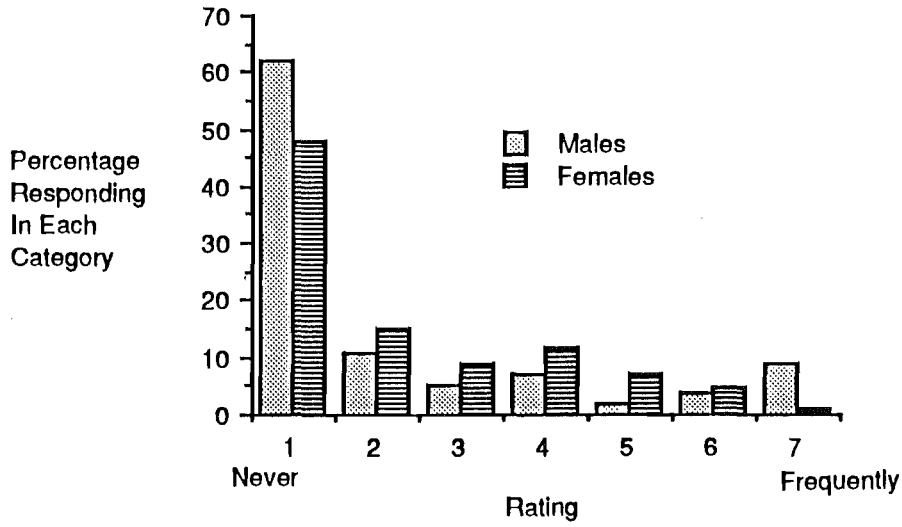

Figure 3.3. Percentage of male and female respondents that gave each rating on the frequency of coded diary entry scale.

were males and 83.8 percent were females. Figure 3.3 shows the percentage of male and female respondents that gave each rating on the frequency of coded diary entry rating scale. Male and female ratings were compared and no significant difference found ($F(1, 277) = 5.275$, n.s.). Therefore, although more female than male diarists made coded diary entries, the female diarists did not do so any more frequently than the male diarists. The use of codes in diaries indicates that information on some activities may simply not be obtainable.

3.3.1.8 Authenticity

The authenticity of diary entries is critical to the validity of Experiment 6. A diary used to obtain autobiographical events for memory experiments that is no more than an "orchestrated litany of lies" will produce completely misleading results. Nor can the consideration of authenticity be confined to deliberate literary dishonesty; unconscious 'tricks' of memory could just as easily lead to incorrect entries. On the other hand, the idea of a diary compiled of deliberate hoaxes hardly makes sense. As Anais Nin (1968) noted about her own diary-keeping, "The secrecy of the diary was a great incentive to honesty" (p. 143). A similar argument has been used by other authors (e.g., Allport, 1942; Fothergill, 1974) in defending the validity of diary entries.

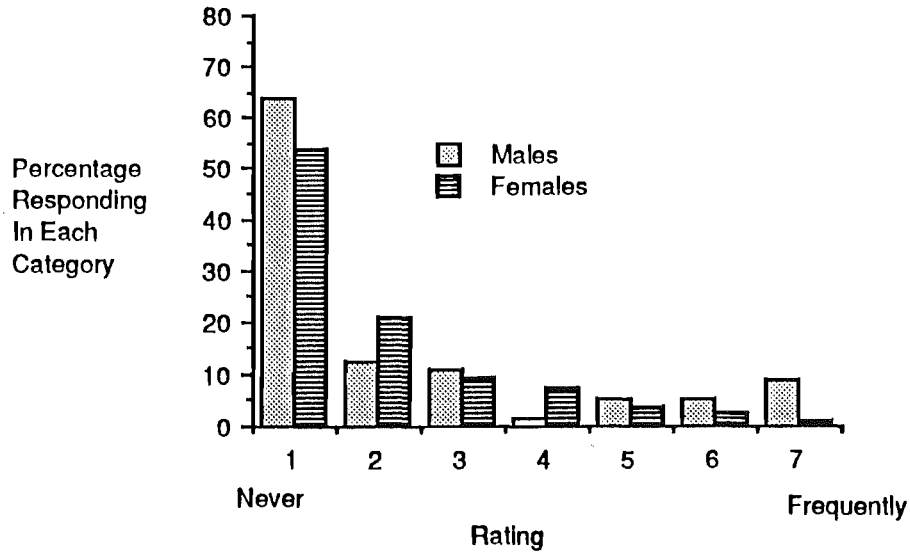

Figure 3.4. The percentage of male and female respondents that gave each rating on the frequency of fabricated diary entry scale.

It does, however, appear that not all diary entries may be factual. Forty-four percent of the student diarists questioned indicated that they had at some time made a fictitious diary entry, of these 20 percent were males and 80 percent were females. Figure 3.4 shows the percentage of male and female respondents that gave each rating on the frequency of 'fabricated diary entry' scale. When the male and female ratings were compared no significant difference was found ($F(1, 277) = 2.641$, n.s.). The fabrication of diary entries appears to be similar to that of coded entries with more females than males having made fictitious entries and no significant difference in the frequency of the activity between the sexes.

One can only speculate on the reasons behind the fabrication of diary entries. A possible explanation was given in the questionnaire, "so as to avoid the true nature of your activities being discovered (e.g., by your parents)" (see Figure 3.1, question 12). This is in line with Ponsonby's (1923) explanation of the use of codes quoted above and seems the most plausible explanation. The significant negative correlation ($r = -.13$, $p < 0.05$) between age in years and the frequency with which entries were fabricated, for the female respondents, supports this explanation. No significant correlation was found for the male respondents. The fear that their activities and feelings might be discovered is likely to be stronger in younger diarists, perhaps still living at home with their parents. Significant positive correlations ($r = .58$, $p < .001$ for male and $r = .20$, $p < .01$ for female respondents) obtained between the use of 'codes' and the 'fabrication' of diary entry frequency ratings, suggest that diarists tend to use both strategies to ensure the secrecy of their activities.

As noted, incorrect diary entries could also result if the diarist failed to recall the facts of the day correctly. However, if diary entries are made daily under the immediate influence of experience, they are unlikely to be much affected by errors of memory. But when are diary entries made? Ninety-six percent of the female and 85 percent of male student respondents indicated they made entries in the evening. Diary entries made in the evening, perhaps just before going to bed, probably relate the events of the day, but it is possible that entries made in the evening are far removed from experience. The diarist may always make entries at this time but not daily, instead periodically making multiple entries to bring the diary up-to-date.

Only 21 percent of the male and 15 percent of the female student diarists sampled indicated they made diary entries every day. Of the student respondents that did not indicate they made entries every day, 55.8 percent of the males and 70.3 percent of the females indicated they would make an entry sometime after the date. The remainder indicated they would leave the page or date blank.

Thus diary entries are not always made under the immediate influence of experience. Although no data exists on how long after events belated entries are made, it would seem reasonable to assume that it would be no more than a few days. As studies in autobiographical memory have consistently found that the recall of autobiographical information is very good (e.g., Linton, 1975; Wagenaar, 1986; White, 1982), it would seem unlikely that a diarist would fail to recall correctly his or her own actions in but a few days. Events that the diarist totally failed to recall would simply not be entered. Therefore, making belated diary entries may only reduce the quantity of material recorded, not its quality or authenticity.

Overall then there is some evidence to suggest that not all diary entries are correct. Furthermore the data on the fabrication of diary entries is inconsistent with Allport's (1942) statement that " . . . as in everyday life the general honesty and creditability of the report can be relied upon" (p. 128). On the other hand, in relation to the use of diaries to obtain autobiographical events for memory experiments, it is probable that diarists who regularly fabricated diary entries would not volunteer to lend their diaries to a researcher.

3.4 The Undirected-Diary Method Compared to Other Research Methods

The use of diaries in psychological research probably declined during the early part of the 20th century because the way in which they were used did not satisfy contemporary scientific standards of sampling, objectivity and validity (Allport, 1942). This criticism of the use of diaries is also applicable to some of the methods currently employed to investigate autobiographical memory. In this section the undirected-diary method is contrasted with other methods currently employed to investigate autobiographical memory.

Much contemporary memory research explicitly tries to avoid the problems of ecological validity associated with traditional research. However, investigating memory as it occurs in everyday life has generally required some sacrifice of control over critical variables (Bahrick & Karis, 1982), and this may be partly responsible for the relative lack of research into autobiographical memory (Brewer, 1986; Robinson, 1976). There are undoubtedly methodological problems associated with some of the techniques currently used to investigate autobiographical memory. Followers of the Ebbinghaus tradition cite these problems as a justification for their methods, suggesting that "attempts to increase ecological validity may actually decrease predictive validity by virtue of a decrease in reliability" (Wilkins, 1986, p. 109). There is, of course, little to be gained by substituting one methodological problem for another.

3.4.1 Verification

A fundamental requirement of memory research is that the subjects have been exposed to some event or stimulus which they can recall. That is,

> " . . . in order to count as memories events, though past, must be stored and hence be potentially available - by being taken out of store - at dates later than the time of original occurrence." (Gruneberg & Morris, 1978, p. 3)

If the researcher has no control over the subjects' acquisition of the information to be recalled, which is generally the case when studying autobiographical memory, an attempt must be made to verify that the subject experienced specific events at specific times. Generally, then, both the time when the information (event) to be recalled was acquired (experienced) and the nature of the information or event should be verified. The issue of verification has been discussed at length by a number of authors (e.g., Bahrick & Karis, 1982; Barclay, 1986; Loftus & Fathi, 1985; Reynolds & Takooshian, 1988; Robinson, 1976; Sanders, 1972; Strube, Knopf & Weinert, 1983), who generally agree that it is desirable, although often difficult. But, as noted by Strube et al., "Veridicality is too important an issue as to be dismissed because of time-consuming effort" (p. 10). On the other hand, there are also some authors (e.g., Edwards & Middleton, 1987; Pillemer & Goldsmith, 1988; Rubin, 1986) that consider the accuracy of memory as only one component

worthy of study, implying that verification is not always essential. As noted by Edwards and Middleton (1987):

> "Precise measures of input-output discrepancies do not reflect what, in many cases, people are trying to achieve in recalling or recounting things. Remembering often serves functions which place a low premium on accuracy." (p. 85)

However, the study of some memory processes such as 'schematization' and 'reconstruction' (Barclay, 1986), the effect of retention interval on recall and the recall of temporal information requires verification.

The degree to which verification can be achieved depends on the particular method adopted by the researcher. The diary method (see Table 3.1, Section 1) allows the researcher to determine the nature of experienced events, and when they were experienced, that is, verification, as do the archival records method (see Table 3.1, Section 4) and the undirected-diary method. In contrast, studies of autobiographical memory which have employed Galton's word association method (see Table 3.1, Section 2), unprompted free recall (see Table 3.1, Section 3), and public events (see Table 3.1, Section 5) do not generally incorporate any 'verification'. An exception is Rubin's (1982) Experiment 5 which had subjects use their diaries to verify the accuracy of dates assigned to events recalled using the unprompted free recall method.

3.4.2 Representativeness

The second methodological issue to be discussed is that of the 'representativeness' of the autobiographical events used in research, and thus the generalizations that can be made. Verification is also important here, as it allows the researcher to objectively define what type of autobiographical information the subjects are attempting to recall. Furthermore, using a research method which does not allow verification (e.g., Galton's word association method, unprompted free recall and the public event method) means the researcher can not determine if recalled events are actually representative of those originally experienced.

Although both the diary method and the archival records method allow verification, and permit the nature of autobiographical events subjects are

attempting to recall to be defined, the representativeness of these events may be affected by the method itself. In relation to the diary method, Quackenbush and Shaffer (1960) noted that there is no assurance that subjects are not selective in what they record. The archival records method is obviously limited to events for which such records are available. The undirected-diary method, on the other hand, perhaps avoids this particular problem; diarists are not aware at the time diary entries are made that they will be questioned on them (the recorded events) at a later date and thus the autobiographical events described in diaries may be more representative of the autobiographical events they have experienced. The problem of representativeness for the diary method has also be partly overcome by Csikszentmihalyi and Figurski (1982). In a study self-awareness and voluntariness to the quality of experience they used an electronic device which emitted signals at random intervals as an indicator of when a subject should record his or her activities (also see Csikszentmihalyi, Larson & Prescott, (1977), Freeman, Csikszentmihalyi & Larson (1986), and Larson & Csikszentmihalyi (1983)).

Quackenbush and Shaffer's (1960) suggestion noted above may be a particularly important consideration if a researcher wished to study a specific aspect of autobiographical memory, such as emotion. Individuals may be particularly selective in recording the emotional content of an autobiographical event. The undirected-diary method, on the other hand, appears to be well suited to such investigations, since the results of the diary-keeping prevalence study indicate that some diaries are specifically kept in order to record emotional experiences. Furthermore, the respondents indicated that diary entries relating to 'personal thoughts and feelings' were frequently made.

Although the autobiographical events and associated information contained within individual diaries may be more representative than that which could be obtained with another method, representativeness may be restricted by two factors. Firstly, the use of codes in diaries suggests information about some types of autobiographical events may be difficult to obtain from this source. Secondly, diary-keeping appears to be particularly prevalent during adolescence, suggesting that obtaining information on autobiographical events from diaries which are representative of other periods of life (e.g., old age) may be difficult. However, the results of the community sample indicated that diary-keeping is not an exclusively adolescent behaviour.

When event dating or the recall of temporal information is being studied, the autobiographical events used in the research should also be representative on this dimension. Studies using the diary method which have examined subjects' ability to recall the year in which the recorded events occurred but only had subjects record events for 3 or 4 months (e.g., Barclay & Wellman, 1986; Thompson, 1982, 1985a; Thompson et al., 1988) may have over-estimated the subjects' ability to recall year of occurrence information simply because the events were not representative in terms of this temporal component. A similar criticism can be made of some studies which have used the archival records method to study the recall of temporal information (e.g., Baddeley et al., 1978; Loftus & Fathi, 1985). The diary method can of course sample longer time periods, as demonstrated by Linton (1975) and Wagenaar (1986), but considerable delay is involved. Such delay can be avoided and representativeness on temporal dimensions achieved by using the undirected-diary method with an adequate sample of diary records (e.g., diary entries covering a number of years).

So far I have focused on the representativeness of the autobiographical events used in research. The representativeness of research results may also be affected by the method used. In relation to the diary method, there is the question of whether recording an event in a diary affects recall, an issue discussed in Section 3.3.1.6. Furthermore, where the diary method is used with a single subject (e.g., Linton, 1975; Wagenaar, 1986; White, 1982) there is the question of whether the memory of this single subject is representative. Replication of the above single subject studies will help answer this question, replication could, of course, be performed across a number of subjects by using the undirected-diary method.

3.4.3 Conclusion

The undirected-diary method appears to overcome a number of the problems inherent in some of the methods used to study autobiographical memory. Verification that a subject experienced a specific event at a specific time is achievable, although the finding that some diary entries are fabrications must be borne in mind. The representativeness of the stimulus material, both in terms of temporal dimensions and the nature of the events, is also probably superior to that achieved with other methods if an adequate

sample of diary records is used. Furthermore, the 'single-subject' problem can be avoided if an adequate sample of diarists is obtained.

The study of autobiographical memory has often resulted in the sacrifice of control over critical variables, however, researchers should not forfeit the opportunity to increase the reliability and validity of their research. The undirected-diary method may provide this opportunity.

CHAPTER 4

METHODOLOGICAL PROCEDURES FOR EXPERIMENT SIX

4.0 Introduction

This chapter details the procedures employed in Experiment 6 and is divided into three sections. The first section describes recruitment of subjects for the experiment. Section two details the diary material obtained from the subjects and the examination of this material. The defining characteristics of the events selected from the diary material are also described. In the final section the formulation and administration of the autobiographical interview schedules are described.

4.1 Obtaining Diarists As Research Participants

The generally held scientific standards of sampling are difficult to observe when conducting research with diarists. The experimenter cannot randomly select subjects and, although the subjects' diary material had to meet certain criteria for participation in the study, the method used to obtain subjects is best described as 'haphazard sampling' (Weisburg & Bowen, 1977): available individuals were used. However, even though no formal sampling procedure was employed, the procedure for recruiting subjects was formalized.

Originally, acquaintances of the experimenter were approached and asked if they had ever kept or were keeping a diary. It was explained that diarists were needed to participate in an autobiographical memory experiment. Four individuals who had diary records expressed an interest in participating and agreed to deliver their diary-records to the experimenter. They were told

not to read through these diary records before bringing them in.[1] Four sets of diary records were delivered to the experimenter early in 1986.

Two of these subjects were subsequently rejected because their diaries provided insufficient material. The other two subjects participated as subjects 1 and 2. Because of recording style, the information required, and omissions (days when no entry was made), the amount of usable dairy information was a relatively small proportion of the submitted material. It was therefore decided that at least one reasonably complete year of records would have to be available for a subject to participate. Because the 'acquaintance' approach to obtaining subjects did not provide enough participants, a more formal strategy was also used.

4.1.1 The Formal Approach to Obtaining Research Participants

The 55 male and 223 female diarists from the student sample in Experiment 5 were given a brief, simple statement about the research, and asked to participate in it. The statement - 'Research Participant Request Form' - was administered with the 'diary-keeping prevalence questionnaire' (see Chapter 3, Section 3.3.1.1), and is shown in Figure 4.1. Eight males and 19 females responded positively, and gave their name, address and phone number. A further 10 males and 29 females removed the detachable section from the request form (This section is not shown in Figure 4.1). Three males subsequently returned this section, two indicating they would like to participate. No attempt was made to contact the other 36 subjects.

The diary-keeping prevalence questionnaire for each of the 29 subjects who expressed an interest in participating in the research was examined. Three males and five females had less than one year of diary records. They were sent a letter of thanks. Appointments were made with the remaining 14 females and 7 males to discuss their participation in the research. These 'briefing' sessions were conducted between the 6th and 16th April 1987, and each lasted approximately 25 minutes. During the briefing session the

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[1] There is no guarantee that these subjects or the others who participated did not read over these diaries before delivering them. However, considering the many hours I required to read the records, 56 in the case of subject 13, for example, it seems unlikely.

Figure 4.1. 'Research Participant Request Form' given to diarists in order to obtain research subjects.

Part of my Ph.D. research involves the study of autobiographical memory using 'personalized autobiographical questionnaires' administered in an interview situation. In order to formulate a questionnaire for an individual I require some verifiable autobiographical information about that individuals past. Individual's diaries are the most comprehensive source of this information. Diaries have, however, not previously been used in this manner to investigate autobiographical memory. The methodology that I am using is therefore new and the results so far look very promising.

In order that these results can be extended and the methodology developed further I require more subjects. Individuals who have participated so far have found the experience enjoyable, it being a unique opportunity to find out about their own memory, engage in some reminiscences, and contribute to the development of a new area of memory research.

Two important points need to be mentioned: (a) All diary material is treated as STRICTLY CONFIDENTIAL. It is kept under lock and key and I am the only person with access to it. Each questionnaire is hand written to ensure confidentiality. (b) Because the interview administration of the questionnaire can take some time I treat each subject to a meal at the end of the sessions.

Would you, as a diary-keeper, like to participate in this research?

method of diary analysis and autobiographical interview schedule construction and administration were covered (These procedures are described in detail later in this chapter). An indication was given as to the time it would take to prepare their autobiographical interview schedule, and how long it would take them to complete it. The confidential treatment of the diaries and the results was noted. It was stressed that the subjects should not look at their diary

material before submitting it. Any questions were answered and the subject asked if he or she wished to participate further.

Fourteen subjects subsequently delivered their diaries and were sent a letter of receipt, which also noted they could withdraw from the research at any time. One female subject withdrew at a later date because she was leaving the University of Canterbury and one male subject was rejected when the examination of his diary records revealed insufficient material.

4.2 Diary Material Submitted By Subjects

Approximately 17,520 pages of diary records were submitted by the 14 subjects that participated in the study. The year or years each subjects' diary records covered, and their interview date(s) are shown in Table 4.1 (see Table 4.5 for the interview dates).

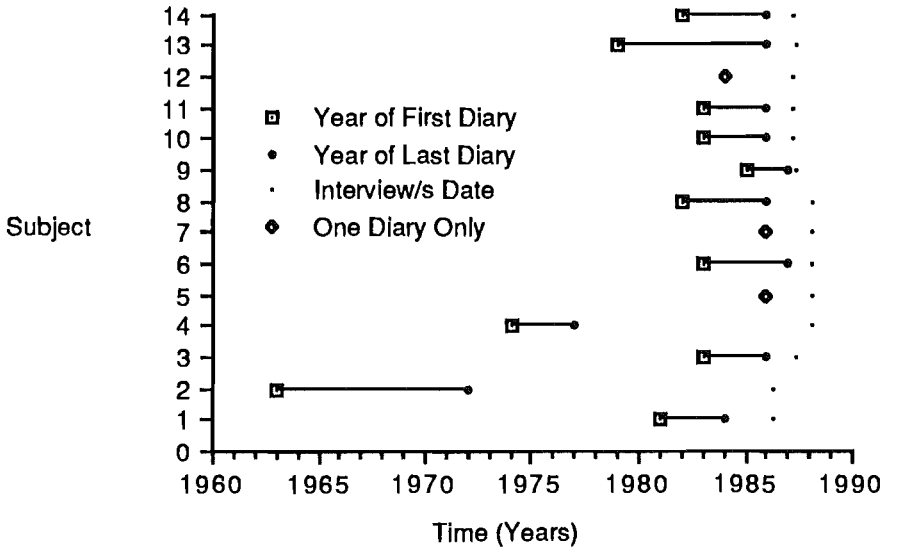

Table 4.1. The year or years of subjects diary records, and interview date(s).

4.3 Examination of the Diary Material and Event Selection

Each subject's diary records were examined systematically for suitable events by the experimenter. Two types of events were searched for in the diaries: 'spontaneous events' and 'duration events'. Selection of the events, both spontaneous and duration, was dependent on the availability of the necessary information, and not random. The defining characteristics of each type of event were carefully considered before the examination of the diaries began.

4.3.1 Spontaneous Events: Definition and Selection

Spontaneous events were defined as events which occurred on a particular day or date. To be considered for selection, four aspects, the what, where, who and when of the event, had to be specified by the diary entry.

'What'

The 'what' aspect is the simplest description of the event, such as "saw the movie "BeetleJuice". 'What' information had to be reasonably detailed for an event to be selected. For example, if the diary record stated that the subject went with John X to the Avon cinema and saw 'a double feature', the event was not selected because 'double feature' was not held to be detailed enough. Care was also taken to ensure that the 'what' aspect did not contain 'where' information. For example, the 'what' aspect for a swimming event would be 'went for a swim' as opposed to 'went for a swim at New Brighton Beach'.

'Where'

The exact location of the event had to be specified, general terms such as cinema and restaurant were not sufficient. Generally the required information was obtained directly from the diary-entry. However, with certain types of events, such as attending movies, plays and exhibitions, it was occasionally possible to obtain the 'where' aspect from an alternative source. For example, a subject may have recorded on the 10th May 1977 that she saw "Jaws II" but not noted where. If she lived in Christchurch at the time (easily determined from the diary), the cinema could be obtained from a back copy of the relevant newspaper. This method of obtaining 'where' information helped increase the number of usable events.

'Who'

For an event to be selected the diarist had to have been personally involved. Thus 'you' was always part of, and sometimes the whole of the 'who' aspect. When other individuals were involved in the event with the diarist, their names were also given. Generally only the first name of each individual involved is recorded in a diary, the exception being where the individual was not well known to the diarist. Those named in the who aspect were those individuals actually named in the diary by the subject rather than all those present. For example, if the subject went to a party the 'who' aspect would name all the individuals the diarist named, if any, and not all the people at the party. In some entries the diarist provided a 'group label' such as 'Christchurch Girls High School pupils' which described all those involved in the event. In such cases this group label was used with 'you' as the 'who' aspect.

'When'

The 'when' aspect was relatively easy to determine, as it was generally either recorded at the beginning of the entry or printed on the top of the page. An event was selected if the day, month and year could all be determined. The day of the week on which the event occurred was also required, and was either obtained directly from the diary records or from a calendar. No more than one spontaneous event was used from a particular day's entry.

4.3.2 Duration Events: Definition and Selection

The defining characteristic of a duration event is that it lasted for more than one day. Two types of duration events were obtained and termed 'filled' and 'empty' duration events. Empty duration events consisted of two associated events separated by some period of time. For example, the individual may have recorded that he sent away an order for a rare stamp and on a subsequent date recorded that he received the stamp. The interval between the two events is assumed to be relatively uncontaminated with associated events, or empty.

Filled duration events consisted of a sequence of spontaneous events that were generally associated because they occurred within a definable interval of time, such as a holiday in Australia. No spontaneous events which occurred within a filled duration were included in the subject's interview

schedule. However, spontaneous events which occurred within empty duration events were included, since these were not associated with the duration event. The actual duration of duration events was obtained from the diary, the day the event began and ended on being both counted as a whole day. More precise timing was usually not possible as diarists rarely recorded time information.

Table 4.2 shows the number of spontaneous and duration events obtained from each subject's diary records, and subject sex and age at the time of the interview schedule administration. It was possible to obtain one spontaneous event from each day that an entry had been made. However, the diarist had to have recorded the necessary information, and

Table 4.2. Subject sex, age and number of spontaneous and duration events obtained from their diaries.

Subject	Sex	Age	Number of Spontaneous Events	Number of Duration Events
1	F	21	80	17
2	F	34	23	11
3	M	19	72	16
4	F	36	77	20
5	F	18	40	6
6	F	21	28	5
7	F	19	17	7
8	M	20	22	5
9	F	18	20	7
10	F	23	19	5
11	M	19	22	4
12	F	18	16	9
13	F	18	188	49
14	F	18	63	26
Overall			687	187

generally sufficient information to define a spontaneous event was encountered only infrequently, most entries simply described a routine day. This is not to say that the selected events were all significant life events, merely that they were important enough for the diarist to record in detail. Duration events, on the other hand, simply appear to be rather rare.

The diarists' recording or entry style also determined the number of events obtained from the diary material. Some individuals regularly used complete literary sentences and included considerable detail. Others, however, omitted details and simply noted the event's occurrence. These factors, along with the selection of filled duration event explain why the number of spontaneous events obtained was sometimes rather small even though a considerable amount of material was submitted.

The examination of the diary material indicated to the experimenter the enormous research potential of such material. However, an experimenter must be prepared to invest considerable effort to obtain the necessary research material: the time required to read through a subject's diary material was, however, related to the legibility of the subject's hand-writing. Fothergill sums up what an experimenter might expect in an examination of diary material:

> "Their chief characteristic is that they go on and on, filled with non-entities and non-events, an endless in-gathering of loose ends. Even the richest and most varied diaries, it must be admitted, are pretty heavy going at times." (Fothergill, 1974, p. 8)

4.4 Categorization of the Autobiographical Events

An essential part of all studies of memory is defining the material to be remembered. In this study a simple phrase such as 'autobiographical events' could be used, however, this is not very informative. It was, therefore, decided to categorize both the spontaneous and duration events obtained from the subjects' diaries into types of events. Knowing the specific types of events and their frequency used in the study was also useful when attempting to generalize about autobiographical memory, and for specific parts of the data analysis.

Categorization was inhibited somewhat by the confidential nature of the autobiographical information: all categorization was performed solely by the experimenter. Furthermore, 87 of the spontaneous events were not easily categorized and would have each required a complete description. Rather than do this and threaten subject confidentiality these 87 events have been categorized only as to whether they involved the subject only or the subject and other individuals.

Table 4.3 shows the result of the spontaneous event categorization: sixty-four different event types are listed under seven general event categories, along with the number of each type of event obtained from the subjects' diaries.

Table 4.3. Spontaneous event categorization labels, and the number of each type of event obtained from the subjects' diaries.

Event Categorization Label	Number of Events
Social Events: A	
Attending a movie at a cinema	114
Watching a movie (video) at a private residence	16
Attending an exhibition	7
Attending a play or musical	40
Seeing a band or orchestra play	19
Seeing a 'dance troop' perform	10
Visited a tourist attraction	8
Attending a sporting event	9
Attending a cabaret	2
Attending a fair/AMP show	8
Sub-total	233
Social Events: B	
Meal at a restaurant	59
Meal at a private residence (invited to diner)	4
Attending a party	33
Attending a dance or ball	5
'Drinks' at a hotel	9
Attending a picnic	6
Attending a barbecue	6
Attending an auction	1
Practical joke/prank	6
Meeting, unexpected - by chance	6
Sub-total	135
Advanced Knowledge Events	
Meeting planed	4
Went on a school field trip	9
Heard speaker at school	2
Attended conference	3
Sat exam or test	2
Posed for official photograph	2
Babysitting	6
Odd-job, single days work	8
Public performance (e.g., delivered speech)	4

Visited doctor or dentist	3
Sub-total	43

Object Association Events

Retail purchase	65
Received a present	14
Made something (creative)	11
Picked something up	13
Found something	3
Received an award or prize	9
Lost something	2
Discovered theft	2
Dropped something off	4
Sub-total	123

Mishaps

Car broke down	7
Accident (non-injury)	9
Accident (injury)	8
Sub-total	24

Recreating - Involved in a Sporting Event

Skiing	5
Canoeing	3
Swimming	10
Squash	1
Roller-skating	1
Fishing	1
Flying	1
Horseriding	2
Iceskating	1
Cards	1
Tennis	2
Golf	1
Video games	1
Gymnastics	4
Shooting	3
Scrabble	1
Tramp/walk	1
Soccer	1
Softball	1
Sub-total	42

Unclassified Events

Miscellaneous events involving subject only	21
Miscellaneous events involving a number of people	66
Sub-total	87
Total	687

Table 4.4 shows the 23 categories used to describe the 187 duration events and the frequency of each type of event obtained from the subjects' diaries. Categorization of the duration events was within the filled and empty duration event categories. In contrast to the spontaneous events, all the duration events were categorized.

Event Categorization Label	Number of Events
Filled Duration Events	
Friend/s come to stay	8
Employed in a job (holiday job)	8
Holiday	49
Official trip (e.g., school trip)	16
Take a course (e.g., Ball-room dancing)	10
Hospitalized	5
Construct something	6
Have a pet animal	5
Medical treatment daily	4
Personal relationship	1
Act in a play	2
Sub-total	114
Empty Duration Events	
Brought or sold something - pick it up or deliver it	15
Received invitation - attend	13
Photograph taken - see it	3
Close friend or relative gos away - returns	7
See movie or play - see it again	2
Order something - it arrives	3
Loose something - recover it	8
Sit test - get results	3
Have something done - have it redone	3
Apply for position - hear result	12
Finish course - start new related course	1
Buy concert ticket - attend concert	3
Sub-total	73
Total	187

Table 4.4. Duration event categorization labels, and the number of each type of event obtained from the subjects diaries.

Examination of Tables 4.3 and 4.4 indicates that the events cover a wide range of human activities, activities that most individuals engage in at some

time. It is my opinion, based partly on my knowledge of the unclassified events, that the results of this study are applicable to most New Zealanders.

4.5 Autobiographical Interview Schedule Formulation and Administration

4.5.1 Spontaneous Events

The event aspects 'what', 'where' and 'who' were used both as cues to prompt recall and as the aspects to be recalled. The 6 sequences in which the event aspects 'what', 'where' and 'who' were presented to the subjects as retrieval cues were randomly assigned to the spontaneous events, each sequence of event aspect cue presentation being assigned to an approximately equal number of events. Each spontaneous event was randomly assigned a position in the interview schedule.

Figure 4.2 shows the format of a spontaneous event question. (Note: the event described in Figure 4.2 and Figure 4.7 are typical, but fictitious.). The details in parentheses were not included in the interview schedule, but describe aspects of the interview schedule format.

Procedure

For each spontaneous event, the subject was first presented one event aspect, either 'what', 'where' or 'who'. In the example shown in Figure 4.2 the What aspect - Saw the movie Jaws II - is the first cue presented. The subject was then required to recall the remaining two event aspects; in the Figure 4.2 example they would be required to state where the event occurred and who was present. Alternatively, they could make a pass response. Such a response category was necessary as the subjects could not respond in a meaningful way to, for example, a 'who' aspect that was simply 'you'. If a pass response was made, the subject had to indicate which of the categories, 1a or 1b, on the Generative Mechanism Card shown in Figure 4.3 best described why it was made. This card was placed on a table in front of the subject.

If the subject made a correct response to either of the two remaining aspects (where and who in the above example), he or she was required to indicate how the response/s was generated using categories 2 to 4 on the

Generative Mechanism Card. Correct responses were defined for each event aspect as: Who - the person/s or group involved in the event in at least as much detail as was recorded in the diary; What - the meaning of the subject's response had to coincide with that recorded in the diary; Where - the specific location recorded in the diary.

21 (Event number)
5 (Order event aspect cues were presented in)

What:....Saw the movie Jaws II.....(First cue presented)
Where:..... (Space to record response and response reason, or pass reason)
Who:..... (Space to record response and response reason, or pass reason)

Where:....At the Avon cinema.....(Second cue presented if pass or incorrect response made above)
Who:..... (Space to record response and response reason, or pass reason)

Who:....You, Jack and Jill..... (Third cue presented if pass or incorrect responses made above)

Rem:..... (Space to record if event was remembered if all cues had to be presented)

When:..... (Space for date response/ reason for date response for each date component)

Date....Thursday 17th May 1984..... (Actual date of event)

Day:..... (Space for day of the week response and reason for response)

Freq:..... (Space for frequency rehearsal rating)
Rec:..... (Space for recency rehearsal rating)

Figure 4.2. An example of the interview schedule format for a spontaneous event.

Incorrect or pass responses after one cue had been presented resulted in the next aspect in the sequence being presented and the same procedure used. In the Figure 4.2 example the second aspect presented is Where - At the Avon cinema.

Figure 4.3. Card used by subjects to indicate the strategy they adopted when recalling information about autobiographical events.

Generative Mechanism Card

(1) Pass : Because (a) the cue or cues are not sufficient for recall, or (b) there are too many possible answers.

(2) Wild guess.

(3) Guessed on the basis of logical inference.

(4) Remembered the answer.

Correct recall of one event aspect on the basis of the first cue, pass responses after the presentation of the first and second cues, or an incorrect response after the presentation of the second cue, resulted in the remaining or third event aspect being presented: Who - You, Jack and Jill - in the Figure 4.2 example. The subject was then asked if they recognized or remembered the

Not-Remembered Event Card

(1) Because the combination of cues does not bring any particular event to mind, but rather a lot of similar ones.

(2) Because the combination of cues does not make any sense at all.

Figure 4.4. Card used by subjects to indicate why they could not recall/recognise specific autobiographical events.

event. If they could not remember the event they were asked to indicate which category on the 'Not-remembered Event Card' best described why. The 'Not-remembered Event Card', which was also placed on the table in front of the subject, is shown in Figure 4.4.

Regardless of whether or not the subject remembered or recognized the event, he or she was required to date it and indicate what day of the week it had occurred on. The date response required three specific components: the year, month and day of the month. The subject used the categories or a combination of categories on the 'Generative Mechanism for Dating Card' to indicate how they had determined each of the date components. The Generative Mechanism for Dating Card is shown in Figure 4.5, and was on the table in front of the subject.

Generative Mechanism for Dating Card

(1) Remembered the answer.

(2) Wild guess.

(3) Inferred the answer using one or more of the following strategies:

(a) Using events that you know occurred before the target event that you know the date of.

(b) Using events that you know occurred after the target event that you know the date of.

(c) Specific information provided by the cues lead you to infer the date. For example, the event obviously occurred in the summer, winter, May holidays etc.

Figure 4.5. Card used by subjects to indicate the strategy they adopted when 'dating' autobiographical events.

Subjects used categories 2 to 4 on the Generative Mechanism Card (Figure 4.3) to indicate how they determined the day of the week the event occurred on. No feedback as to the accuracy of the date or day of week responses was given to the subject.

Finally, events that were remembered, indicated by one or more event aspects being correctly recalled or by subjects stating they recognized the event after all the event aspects were presented, were rated on two rehearsal scales, recency and frequency. Figure 4.6 shows the two rehearsal scales.

Rehearsal Rating Card

RECENCY	FREQUENCY
(1) In the first week following the event.	(1) Once.
(2)	(2)
(3)	(3)
(4)	(4)
(5)	(5)
(6)	(6)
(7) In the last week.	(7) Very frequently.

Figure 4.6. Rating scales used by subjects to rate the frequency and recency of autobiographical event rehearsal.

4.5.2 Duration Events

For duration questions the subjects rated their knowledge of the event and estimated its duration; the order in which these responses were obtained was randomly assigned to an approximately equal number of events. Each duration event was randomly assigned a position in the interview schedule.

The details of a duration event obtained from the subjects' diaries were formulated into an event description. Figure 4.7 shows an example of the interview schedule format of an empty duration event. The event description

in this example describes the two associated marker events. The event description for a filled duration event required only a single statement, such as "You and Paul went on a holiday to Australia". A duration question relating to the event description was also formulated. In the above filled duration event example it would be "How long were you and Paul in Australia?".

2 (Event number)

R/D (Order subject gave knowledge rating and duration estimate)

KR:..... (Space for knowledge rating)

Fre:..... (Space for frequency rehearsal rating)

Rec:..... (Space for recency rehearsal rating)

Est:..... (Space for duration estimate)

Act: 51 days – Fri 6th March to Mon 25th April, 1984 (Actual duration)

You ordered some computer discs from Japan.
Some time later they arrived.
(Event description)

How long after ordering the discs did they arrive?
(Duration question)

Figure 4.7. An example of the interview schedule format for a duration event.

Procedure

For the duration event questions, the event description was first read to the subject. The subject then either first answered the duration question or rated the event on the knowledge rating scale. Both responses were thus obtained in a random order for each event. The knowledge rating scale is

shown in Figure 4.8. Duration estimates were in terms of days, weeks, or months, or some combination of these. Subjects were instructed to count both the day the event began and ended on as a complete day. Events that the subject remembered, indicated by their response on the knowledge rating scale, were rated on the two rehearsal scales, shown in Figure 4.6

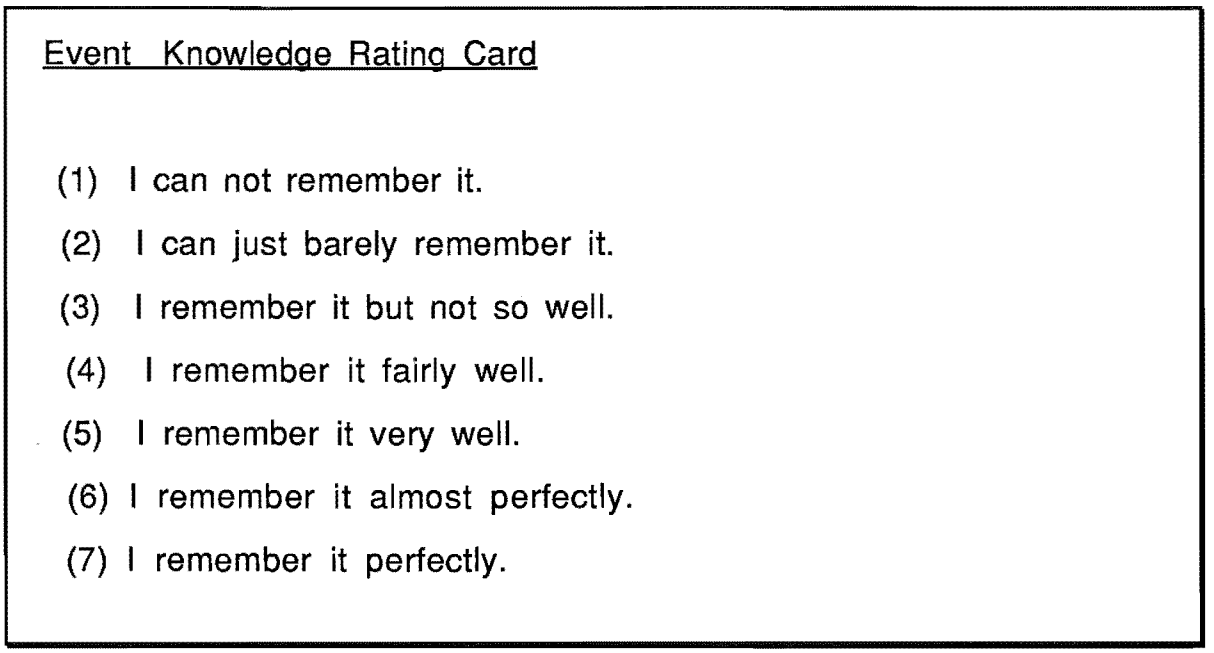

Figure 4.8. Scale used by subjects to rate event knowledge.

In order to ensure confidentiality, the interview schedule for each of the 14 subjects was hand-written by the experimenter. The formulation of interview schedules and administration procedure for subjects 1 and 2 was somewhat different to that described above as the procedure was modified on the basis of their results. Originally, space was provided on the interview schedule format of both spontaneous and duration events for subject ratings on pleasantness, salience and emotional involvement scales. These scales were dropped from the procedure because: (a) subject 1 and 2 expressed difficulty in using them retrospectively, (b) the original procedure was very time consuming, and (c) examination of the use of these scales by subjects 1 and 2 suggested that the ratings did not provide a basis for meaningful analysis.

The interview procedure was explained to the subject at the beginning of the first interview and reiterated at subsequent interviews if required. The characteristics of the two types of questions, spontaneous and duration event

questions, were covered separately. It was noted that the questions would be presented in a random (non-temporal) sequence and that there was no time limit for answering questions.

The subjects' responses were recorded in their interview schedule by the experimenter. Interviews were conducted at the University of Canterbury. No single interview lasted for more than two hours, but some subjects participated in more than one interview. Table 4.5 shows the date or dates subjects were interviewed on.

Subject	Date of Interview
1	14 Oct 1986, 28 Oct 1986, 26 Nov 1986
2	12 Nov 1986, 12 Dec 1986
3	25 Nov 1987, 27 Nov 1987, 18 Dec 1987
4	23 Mar 1988, 13 Apr 1988, 20 Apr 1988, 29 Apr 1988
5	12 Apr 1988, 20 Apr 1988
6	17 March 1988
7	30 Apr 1988
8	9 Apr 1988
9	30 Sep 1987
10	2 Oct 1987
11	28 Sep 1987
12	28 Sep 1987
13	31 Jul 1987, 7 Aug 1987, 18 Sep 1987, 25 Sep 1987, 20 Nov 1987, 23 Nov 1987
14	7 Aug 1987, 29 Sep 1987

Table 4.5. Subject interview dates.

On completion of the interview schedule the subject was reminded that he or she was entitled to a meal at a restaurant. Two subjects declined this offer, one stating 'the experience was rewarding enough in itself". All subjects were given the opportunity to look back over their responses, and questions they had about the research were answered.

Diary material was then returned to the subject, along with the 'Subject Participation Questionnaire', which related to their participation in this research and to this type of research in general. Subjects were asked to complete the questionnaire and return it by mail. A stamped, addressed envelope was supplied. Subjects 1 and 2 were not given this questionnaire.

CHAPTER 5

AUTOBIOGRAPHICAL EVENT MEMORY: EXPERIMENT SIX - RESULTS AND DISCUSSION

5.0 Introduction

This chapter is divided into three sections. The first section focuses on the undirected-diary method, and deals with the results of the 'subject participation questionnaire'. Sections two and three contain the results of Experiment 6: section two the spontaneous event results (Experiment 6, Part a), and section three the duration event results (Experiment 6, Part b).

The predominant approach taken in experimental design and data analysis within psychology is undoubtedly nomothetic. Data is gathered from a reasonable sample of subjects and the subjects form the random variable in the analysis. This approach enhances the reliability of generalizations suggested in the obtained results. In line with this trend the data obtained from the 14 subjects are generally combined for analysis, however, rather than subjects forming the random variable, events are used. Furthermore, because the sample size is relatively small, the reliability of between-subject results is explicitly investigated using within-subject analyses. It was, however, not possible to assess reliability in this manner at all points during the data analysis, primarily because dividing the data up, for example, into filled and empty duration events, drastically reduced the within-subject cell sizes.

5.1 Subject Participation Questionnaire: Results and Discussion

Figure 5.1 shows the questions relating to research participation in the subject participation questionnaire. Of the twelve questionnaires distributed 10 were returned, 7 completed by female subjects and 3 by male subjects.

The subjects enjoyed participating in the research, as indicated by the mean response to question 3: 6.3 for the males and 6.2 for the females. This result may account for the high level of motivation shown by the subjects at the interview stage, and is of some importance to the validity of Experiment 6

as a whole. If the subjects had not enjoyed the experience, the results would have to be regarded as suspect, particularly considering the many hours of interviewing involved. All subjects responded positively to question 5, which can be interpreted as another indication that the subjects enjoyed participating in the research.

(3) Did you enjoy being involved in the research?
Not at all .....I.....I.....I.....I.....I.....I..... Very much
1 7

(4) Would you have become involved if the experimenter was:
(a) Female? Yes..... No..... (d) A lecturer? Yes..... No.....
(b) A lot older? Yes..... No..... (e) An undergraduate? Yes..... No.....
(c) A lot younger? Yes..... No.....

(5) Would you agree to be reinterviewed if I asked you in say 20 years (for a suitable reward)? Yes..... No.....

(6) If the nature of the research was different, that is, not concerned with memory, but rather focusing on, for example,
(a) Developmental issues Yes..... No.....
(b) Interpersonal relationships Yes..... No.....
(c) Individuals thoughts and feelings towards specific events, would you still have participated? Yes..... No.....
(Answer for each example given)

Figure 5.1. Questions relating to research participation contained in the research participation questionnaire.

Responses to part a and b of question 4 were all positive. However, five subjects responded negatively to parts c and e, and one to part d. These results indicate that certain characteristics of the experimenter might influence a subject's willingness to participate in this type of research.

Finally, the responses to question 6 were generally positive, but, one female subject responded negatively to parts a and c, and one male and two females gave a negative response to part b. These results indicate that the nature of the research might have an effect on subject availability. However, most responses to question 6 were positive indicating that other research topics could be investigated using the undirected-diary method.

5.2 Experiment 6, Part A: Spontaneous Events - Results and Discussion

Six hundred and eighty-seven spontaneous event questions were answered by the 14 subjects. Retention interval (the time between the date the event occurred on and the interview date) ranged from 226 days to almost 25 years, with a median of 1333 days. The event aspect cue presentation sequences: 'Who, What, Where', 'Who, Where, What', 'Where, Who, What', 'Where, What, Who', 'What, Where, Who', and 'What, Who, Where' were used 109, 115, 127, 101, 121, and 114 times, respectively.

5.2.1 Event Aspect Cuing Efficiency

In this section the event aspect cues (what, where and who) are examined both as cues to prompt recall and as aspects to be recalled. Table 5.1 shows the percentage of times each event aspect was given correctly after the presentation of <u>one</u> event aspect cue only. Examination of Table 5.1 indicates that the 'what' cue was the most efficient as a prompt to recall, followed by 'where' and 'who'. This result is similar to that found by Wagenaar (1986), who suggested the power of a cue depends on its uniqueness. 'What', or the nature of an event, is more likely to be a unique aspect as one often engages in novel activities in familiar surroundings with the same individual or group of people. Thus the same where and who information may be associated with many specific events: for example, one might see, in the company of one's wife, ten different plays at the same theatre over a season. While in the above example the same where and who aspects are associated with each different play seen during the season, the what aspect is unique, in that each play would be different.

Cue Presented	Correct Response Given to:		
	What	Where	Who
What		41.7	45.1
Where	21.9		19.7
Who	7.5	8.9	

Table 5.1. Percentage of each type of event aspect correctly recalled after the presentation of one event aspect cue only.

Prompt efficiency was also examined for each subject separately. Table 5.2 shows for each subject the percentage of the remaining two event aspects that were correctly recalled after the presentation of one cue for each cue type. Examination of Table 5.2 indicates that the ranking of cue efficiency for ten of

Subjects	Number of Spontaneous Events	Percentage of Remaining Two Event Aspects Correctly Recalled After a What Cue Only	Percentage of Remaining Two Event Aspects Correctly Recalled after a Where Cue Only	Percentage of Remaining Two Event Aspects Correctly Recalled After a Who Cue Only
1	80	35.7	6.2	3.5
2	23	62.5	0	12.5
3	72	30.0	20.0	4.5
4	77	20.3	20.0	2.0
5	40	53.8	17.8	0
6	28	43.7	20.0	10.0
7	17	30.0	28.5	40.0
8	22	75.0	42.8	14.2
9	20	42.8	50.0	16.6
10	19	14.2	50.0	0
11	22	64.2	28.5	37.5
12	16	28.5	10.0	12.5
13	188	47.6	19.0	6.4
14	63	70.4	23.8	10.0

Table 5.2. Percentage of the two remaining event aspects correctly recalled after the presentation of one event aspect cue for each cue type.

the subjects follows the overall result pattern of what, where and who, from most to least efficient. For the other four subjects (subjects 7, 9, 10, 11) this pattern is not apparent, subject 7 provided the most correct responses on the bases of who cues, while subjects 9 and 10 achieved this on the bases of where cues. For subject 11 the what cue was the most efficiency, but who was slightly more efficient than where.

Two factors need to be noted about subject's 7, 9, 10 and 11's results. First, these subjects are generally those who responded to the smallest number of spontaneous event questions, thus the their cell percentages are calculated on very small sample sizes. Second, the results of these four subjects are not consistent, that is, their cue efficiency rankings are not all the same, which suggests their results can not be used to question the validity of the overall cue efficiency ranking.

Further evidence of the usefulness of 'what' as a prompt to recall is seen in Table 5.3 in which the percentage of times each event aspect was given correctly on the basis of two event aspect cues are shown. Providing subjects with a second cue resulted in an increase in the probability of recall of the third aspect, particularly if one of the two cues given was the 'what' cue. Table 5.1

Table 5.3. Percentage of each type of event aspect correctly recalled after the presentation of two cues.

Cues Presented	Correct Response Given to:		
	Where	Who	What
What - Who	50.6		
What - Where		47.2	
Who - Where			25.2

and 5.2 show that the presentation of a 'who' or a 'where' cue produced a relatively small number of correct responses, Table 5.3, on the other hand, shows that the 'who-what' and 'where-what' cue combinations produced a

reasonable number of correct responses. Furthermore, the percentage of correct responses after a what and who, and what and where cue, shown in Table 5.3 are similar to percentage of correct responses after only a what cue shown in Table 5.1. Therefore, the prompt value of the 'who-what' and 'where-what' cue combinations probably reflects the fact that the 'what' aspect was part of the combination. In other words, providing the extra information of 'who' and 'where' with a 'what' cue only slightly facilitated recall, while providing 'what' as the second cue appears to have been a major factor contributing to the value of the 'who-what', 'where-what' cue combinations.

The reasons subjects gave for making a 'pass' response also support a 'uniqueness' explanation of event aspect efficiency as a prompt to recall. Overall, 74.9 percent of pass responses were stated as being made because there were 'too many possible answers', the remaining 25.1 percent being attributed to the cue or cues provided not being sufficient for recall. In other words, generally the presented event aspect produced some recall but the prompt aspect was not 'unique' (specific) enough for the subject to be certain which event was being referred to. In line with the above results suggesting 'what' was the most efficient prompt because it was more likely to be unique, when only a 'what' cue had been presented 67.5 percent of pass responses were attributed to there being too many possible answers compared to 84.9 and 82.9 percent after the presentation of only a who or a where respectively. Thus, 'what' alone as a prompt to recall apparently did not result in as many similar events being recalled as was the case when either a 'who' or a 'where' cue were presented.

Table 5.4 shows for each subject the percentage of 'too many possible answer ' passes after the presentation of one cue for each cue type, and the overall distribution of the two types of pass responses after one cue had been presented. In line with the overall results, 12 of the subjects made more too many possible answer passes than insufficient cue passes. Furthermore, examination of the percentage of too many possible answer passes across cue types shows that 7 of the subjects made fewer too many possible answer passes after a what cue than after a who or a where cue, which supports the validity of the overall result reported above. Of the other subjects, only subject 11 gave substantially more too many possible answer passes after a what cue than after other cues.

Subject	Percentage of 'Too Many Possible Answer' Pass Responses Made After The Presentation of Only a:			Percentage of Each Type of Pass Response Made Overall	
	What Cue	Where Cue	Who Cue	Insufficient Cues	Too Many Answers
1	48.2	95.4	92.5	14.5	85.5
2	60.0	71.4	100.0	17.6	76.4
3	75.0	80.0	71.5	24.5	75.5
4	82.3	81.2	87.0	17.6	82.4
5	66.7	100.0	66.7	25.0	75.0
6	75.0	75.0	100.0	14.2	85.5
7	100.0	40.0	100.0	30.0	70.0
8	0	50.0	80.0	44.4	55.6
9	75.0	100.0	100.0	8.3	91.7
10	50.0	100.0	66.7	30.7	69.3
11	50.0	25.0	20.0	72.7	27.3
12	20.0	11.2	28.6	80.7	19.3
13	75.0	90.0	93.2	11.7	88.3
14	87.0	93.7	88.9	9.2	90.8

Table 5.4. Percentage of 'too many possible answer' pass responses made after the presentation of one cue for each cue type, and the overall distribution of the two types of pass response after one cue.

Overall, the reasons subjects gave for recalling an event aspect suggest that a conservative approach to recall was usually taken. After receiving one event aspect cue, subjects indicated that they 'guessed' the remaining two event aspects 2.2 percent of the time and inferred them 1.9 percent of the time, while after receiving two event aspect cues, 3.6 percent of responses were guessed and 3.8 percent were inferred. Hence, generally the subjects indicated responses were 'remembered'. The particularly small number of event aspects that were guessed or inferred suggests the subjects tended to prefer to feel they remembered the required information before providing it, rather than attempting to guess or infer it on the basis of limited cues. On the other hand, the small number of inferences may indicate that the subjects were not generally capable of inferring the required information. However, the finding that 77.2 percent of the 45 inferences made were correct is not consistent with this alternative explanation.

5.2.2 Retention Interval and Event Memory

In order to examine the effect of retention interval on recall, retention interval was divided into 6 month blocks and the percentage of events remembered within each block calculated. Both recalled and recognized events were defined as remembered, that is, when an event aspect was correctly recalled on the basis of one event aspect cue or set of cues, or when the subject stated they recognized the event after all event aspect cues had been presented. Figure 5.2 shows the percentage of events 'remembered' plotted against retention interval. Only the first 14 six month retention interval blocks are shown, as a criterion of a minimum of 17 spontaneous events per block was set.

Inspection of Figure 5.2 suggests that autobiographical event memory declines only gradually over time. Indeed over the first 7 years of retention interval (those shown in Figure 5.2) 80 percent of the events were remembered, while 57.2 percent of the events which occurred between 7 and 12 years before the interview, and 63.6 percent of the events which occurred between 12, and approximately, 25 years before, were also remembered. Overall 76.4 percent of the events were remembered by the subjects.

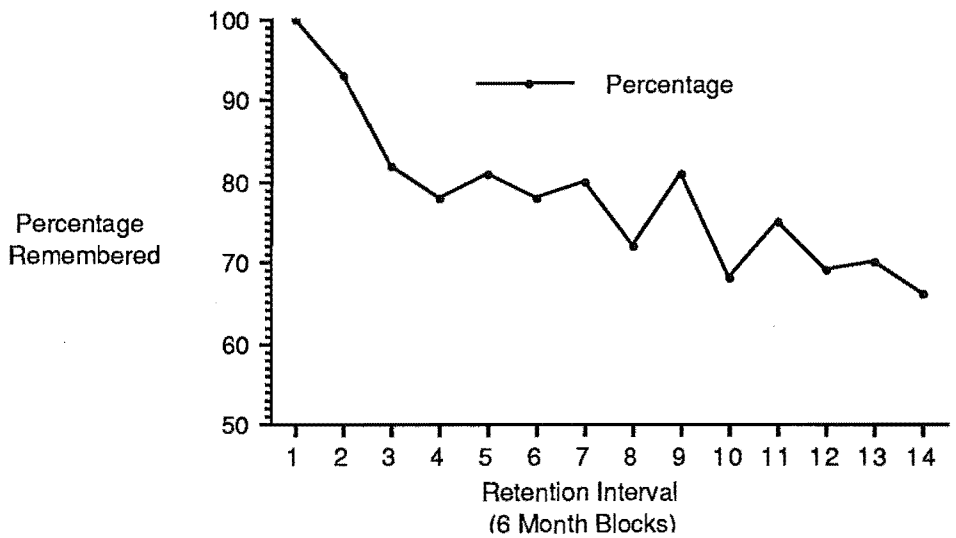

Figure 5.2. Percentage of spontaneous events remembered in each 6 month retention interval block.

A simple power function of $Y=1.99\ x^{-0.13}$ (r=.84) was obtained for the retention interval curve shown in Figure 5.2. The exponent is somewhat smaller than the -0.36 obtained by Wagenaar (1986) and suggests that overall the subjects in this experiment were able to recall more autobiographical events. Indeed, inspection of Wagenaar's retention curve (Figure 2, p. 232) indicates that at his longest retention interval, 5 years, correct recall was only 30 percent, compared to 68 percent at the same retention interval in this experiment.

The retention interval curve shown in Figure 5.2 may of course reflect subject differences; this is possible because retention interval varied between the subjects. It is possible that subjects with long retention intervals were not very good at remembering their events and subjects with relatively short retention intervals were quite good. In order to examine this possibility retention interval was divided in half and the percentage of forgotten events in each half calculated for the 9 subjects that forgot more than 5 events in total. Figure 5.3 shows for each subject the percentage of forgotten events in the remote and recent half of their retention interval. Examination of Figure 5.3

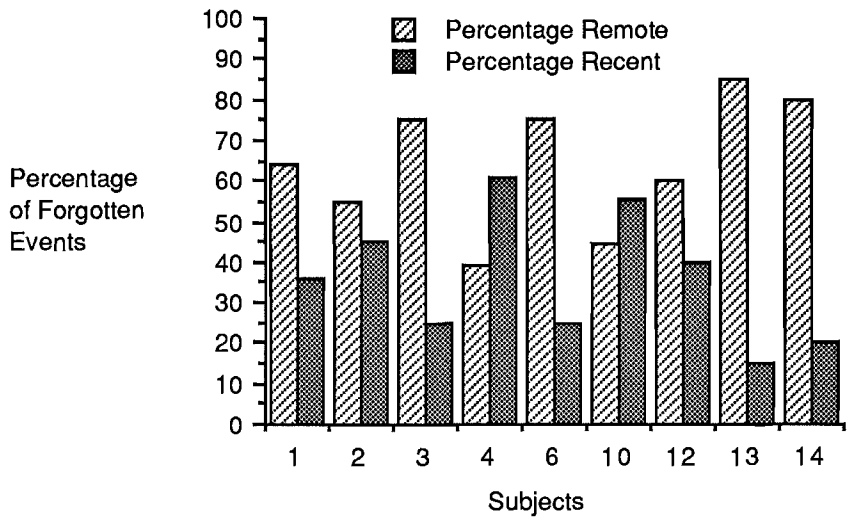

Figure 5.3. Percentage of events forgotten in the remote and recent half of subjects retention interval.

indicates that 7 of the subjects forgot more remote events than recent events. Thus remembering decreased as retention interval increased. This within-

subject result suggests the overall result (Figure 5.2) is a valid representation of the subjects autobiographical event memory.

5.2.3 Forgetting

One hundred and sixty-two events were 'not remembered' by the subjects. It is unlikely that these events were completely forgotten; rather, in line with Wagenaar's (1986) definition of forgetting, that they could not be remembered on the basis of the event aspect cues presented. It is probable, as Wagenaar (1986) found, that given more information, some of the forgotten events would have been remembered. This is particularly true of the 103 forgotten events to which subjects reported that the presented event aspects did not stimulate a particular event memory 'but rather a lot of similar ones'. Probably here the subject was aware that the event had previously occurred, but was not sure exactly which event was being described. For the remaining 59 forgotten events forgetting was attributed to the combination of event aspects presented 'not making any sense'. Thus the event described appeared foreign, and not something that the subjects remembered occurring in their lives.

Table 5.5. Number of events remembered and frequency of reasons given for forgetting for each subject.

Subject	Number of Remembered Events	Number of Forgotten - Similar Events	Number of Forgotten - Foreign Events	Percentage of Events Forgotten
1	66	5	9	17.5
2	14	4	5	39.1
3	48	14	10	33.3
4	49	21	7	36.3
5	36	3	1	10.0
6	21	3	4	25.0
7	14	2	1	17.6
8	20	1	1	9.0
9	16	3	1	20.0
10	10	5	4	47.3
11	21	1	0	4.5
12	11	3	2	31.2
13	141	33	14	25.0
14	58	5	0	7.9
Total	525	103	59	23.6

Table 5.5 shows the number of events remembered and the frequency of attributed reasons for forgetting for each subject. The two groups of forgotten events are, for convenience, labelled as 'forgotten-similar' and 'forgotten-foreign' in line with the above discussion. Inspection of Table 5.5 indicates that 10 of the subjects forgot more events because they were similar to other events, suggesting that the overall distribution of the reasons for event forgetting is a reasonably valid result.

The percentage of events within each of the seven general event categories (defined in Section 4.4, Chapter 4) which were forgotten is shown in Table 5.6 separately for the forgotten-similar and forgotten-foreign categories. Comparison of the percentage of forgotten-foreign events in each category

Table 5.6. Percentage of forgotten-similar and forgotten-foreign events within each of the seven general event categories defined in Chapter 4, Section 4.4.

General Event Category	Number of Events	Percentage of Forgotten - Similar	Percentage of Forgotten - Foreign
Social : A	233	10.3	7.2
Social : B	135	16.2	6.6
Advance Knowledge Events	43	30.2	6.9
Object Association Events	123	21.9	8.9
Mishaps	24	0	12.5
Recreating	42	12.6	13.7
Unclassified	87	12.6	13.7

indicated they were similar X^2 (6, N = 687) = 4.41, n.s.. The percentage of forgotten-similar events, on the other hand, does vary across the categories X^2 (6, N = 687) = 18.18, $P < .01$. However, it is not surprising that no events categorized as 'mishaps' were 'forgotten-similar', as one would not expect that the subjects would have experienced a large number of similar accidents, accidents being the type of event which make up the majority of this category.

In contrast, the advance knowledge event category which has the largest number of forgotten-similar events does contain events, such as baby-sitting, attending a meeting, visiting a doctor or dentist, which one might expect would occur reasonably frequently (see Table 4.3, Chapter 4, for the complete list of advanced knowledge events).

The retention interval for the forgotten-similar and forgotten-foreign events was compared, and no significant difference was found (F (1, 161) = 1.955, n.s.), with the group mean retention intervals being 6.55 years and 6.92 years, respectively. Thus, the type of forgetting was independent of retention interval. The results reported in Section 5.2.2, of course, indicate that overall forgetting is related to retention interval. Further evidence of this was found when the retention interval of the remembered events was compared with that of the forgotten events (F (2, 684) = 1.324, $p < .0001$). An *a posteriori* contrast using the Scheff'e test indicated that the remembered event retention interval mean of 4.57 years was significantly different ($p < .05$) from both the forgotten-similar and forgotten-foreign event retention interval means. Thus, the forgotten events were generally older than the remembered events.

5.2.4 Recall of Day of the Week

Subjects were required to indicate which day of the week each event had occurred on, even if they could not remember the event. A correct day response was given for 252 or 36.6 percent of the events which is substantially greater than the 98 correct responses expected by chance (1 in 7). The relatively high proportion of events that were given a correct day response suggests the subjects were quite good at providing this type of event information. Table 5.7 shows the distribution of response strategies the subjects indicated they adopted for the remembered, forgotten-similar and forgotten-foreign events, and the percentage of times each strategy produced a correct day response.

Examination of Table 5.7 suggests that the percentage of correct guesses is only just above the chance level, while the percentage of day of the week responses that were correctly inferred and remembered is quite high. The subjects' ability to infer what day of the week an event occurred on appears to be particularly good. It is also interesting to note that a small number of day responses were stated as remembered even though the event was forgotten, none of these responses were, however, correct.

Event Type	Number of Guessed Responses	Percentage Correct	Number of Inferred Responses	Percentage Correct	Number of Remember Responses	Percentage Correct
Remembered	242	16.9	223	50.7	60	78.3
Forgotten-Similar	58	18.9	42	61.7	3	0
Forgotten-Foreign	45	15.5	12	58.3	2	0
Total	345	17.1	277	52.7	65	72.3

Table 5.7. The day of the week response strategies distribution for the remembered, forgotten-similar and forgotten-foreign events.

Overall 38.2 percent of the remembered, and 31.4 percent of the forgotten (forgotten-similar and forgotten-foreign combined), events were given a correct day of the week response. A comparison of these proportions revealed no significant difference (Z=1.623, n.s), suggesting that correctly identifying the day of the week an event occurred on was not dependent on actually remembering the event. Furthermore, both of the above percent values are more than twice the 14 percent correct expected by chance.

Table 5.8 shows the distribution of response strategies adopted by each subject and the percentage of times each response strategy produced a correct day response, the overall percentage correct for each subject is also shown. Both remembered and forgotten events are included in the table. Inspection of the overall percent correct for each subject shown in Table 5.8 suggests the subjects were reasonably similar in their ability to correctly determine what day of the week an event occurred on. Furthermore, when each subjects overall percent correct was compared with their expected value based on chance, all subjects were found to have performed above the chance level, which is consistent with the overall result reported above.

Examination of the distribution of response strategies and the percent of correct responses each strategy produced for each subject (Table 5.8) suggests that the subjects were similar in terms of their ability to guess and correctly

infer what day of the week an event occurred on. However, there is some evidence of individual differences in remembering this information.

Subject	Number of Guessed Responses	Percentage Correct	Number of Inferred Responses	Percentage Correct	Number of Remember Responses	Percentage Correct	Overall Percentage Correct
1	36	11.1	40	45.0	4	25.0	28.7
2	9	11.1	12	58.3	2	50.0	39.1
3	32	9.3	36	41.6	4	0	25.0
4	38	15.7	37	51.3	2	100.0	35.0
5	21	9.5	15	46.6	4	100.0	32.5
6	16	12.5	12	41.6	0	0	25.0
7	7	28.5	3	33.3	7	100.0	58.8
8	11	9.0	5	40.0	6	33.3	22.7
9	9	22.2	10	70.0	1	0	45.0
10	12	16.6	5	20.0	2	0	15.7
11	7	14.2	4	75.0	11	100.0	68.1
12	8	25.0	8	37.5	0	0	31.2
13	122	22.1	52	73.0	14	85.7	40.9
14	17	23.5	38	52.6	8	87.5	49.2

Table 5.8. The distribution of the day of the week response strategies adopted by each subject, and the percentage of times each response strategy produced a correct response.

The distribution of the response strategies, in terms of percentages, for each of the seven days of the week that the target event actually occurred on, and the percentage of times each strategy produced a correct day response are shown in Table 5.9. Both remembered and forgotten events are included in the table. Examination of Table 5.9 suggests that whether the subjects adopted a 'guess' or 'inference' strategy when giving a day of the week response depended on what day of the week the event actually occurred on. Tests of proportional difference confirmed this with significantly more guessed responses for Monday, Tuesday, Wednesday and Thursday events ($Z= 6.70$), and significantly more inferred responses for Friday, Saturday and Sunday events ($Z= 4.42$). Correctly inferring what day of the week an event occurred on also depended on its actual day of occurrence; Friday, Saturday and Sunday events produced significantly more correct inferred responses ($Z= 4.37$), while significantly more Monday, Tuesday, Wednesday and Thursday events were correctly guessed ($Z=16.04$).

Remembering what day of the week an event occurred on also varied with the actual day of the week the event occurred on. Significantly more responses to Friday, Saturday and Sunday events were stated to be remembered (Z=14.67). Furthermore, significantly more 'remembered' Friday, Saturday and Sunday responses were correct than remembered Monday, Tuesday, Wednesday and Thursday event responses. It is also interesting to note that no Monday events were correctly remembered at all.

Table 5.9. Percentage of response strategies, and percentage of times each strategy produced a correct day response, for each day of the week.

Day of the Week	N=	Percentage Guessed	Percentage of Correct Guesses	Percentage Inferred	Percentage of Correct Inferences	Percentage Remembered	Percentage Remembered Correctly
Monday	79	64.6	9.8	30.4	4.1	5.0	0
Tuesday	81	71.6	18.9	24.7	25.0	3.7	100.0
Wednesday	90	60.0	25.9	36.7	24.2	3.3	66.6
Thursday	74	58.2	16.2	33.7	44.0	8.1	50.0
Sub-total		63.6	52.8	31.5	35.7	4.9	11.5
Friday	150	43.4	13.8	40.6	56.0	16.0	70.8
Saturday	150	31.4	23.4	56.0	80.9	12.6	89.4
Sunday	63	42.8	7.4	47.7	56.6	9.5	83.3
Sub-total		38.0	12.2	48.0	66.1	14.0	21.7

The increase in inferred day of the week responses for events that occurred on a Friday, Saturday and Sunday is probably related to the types of events that occur on these days. Indeed, 5 types of event, attending a movie, retail purchase, attending a party, attending a play or musical, and restaurant meal, accounted for 51.2 percent of all the inferred day of the week responses, while 52.2 percent of these events actually occurred on a Friday, Saturday, or Sunday.

5.2.5 Recall of Date of Occurrence

In order to ensure the validity of the date response analyses, data from three of the subjects (subjects 5, 7, and 12) were not used, because the

spontaneous event questions of these three subjects (N=73 in total) were obtained from a single year of diary records. As each of these subjects knew what year their submitted diary related to, and thus what year the spontaneous events occurred in, their date responses would probably have over-estimated general dating accuracy. The remaining 11 subjects each submitted at least 3 years of diary records, with a mean of 5 years. Six-hundred and fourteen spontaneous events were dated by these subjects.

5.2.5.1 Dating Accuracy: Absolute Error

The median actual date of the 614 dated events was the 30th January 1984 while the median assigned date was the 25th March 1984. This result suggests that the subjects might have been quite accurate at determining when an event occurred. Further evidence of this accuracy is given by the high correlation ($r = .98$, $p < .0001$) between actual and assigned date. A similar correlation was obtained when only the remembered events were used in the calculation ($r = .98$, $p < .0001$). Also of interest are the correlations obtained when only the forgotten-similar and forgotten-foreign events were examined ($r = .97$, $p < .0001$) and ($r = .99$, $p < .0001$) respectively. Overall, these results suggest that the subjects were capable of determining when their events had occurred, even when they could not actually remember the event.

Assigned and actual event date were also correlated for each subject separately. Table 5.10 shows the obtained correlations. Also shown are the median absolute error, and median retention interval, and correlations between absolute dating error and retention interval (All results are ranked according to median retention interval). The results shown in Table 5.10 were calculated using all of the events dated by each subject. Calculating these results separately for the forgotten events only was impractical as the number of events forgotten by each subject was generally too small to produce meaningful data. Regardless of this point, combining all of each subject's data for this set of analyses seemed reasonable as the previous results suggest that the date responses to forgotten events are not unduly inaccurate.

Inspection of the correlations between assigned and actual date shown in Table 5.10, all eleven of which are positive and significant, indicates that all the subjects were reasonably capable of determining when their events occurred, and suggests that the overall result is valid. However, examination

of the median absolute error for each subject suggests that in general the assigned dates were not particularly accurate, with an overall median absolute error of 66 days. A slightly smaller overall median absolute error (52.1 days) was found when calculated using the remembered events only.

Table 5.10. Median absolute dating error, median retention interval, and the correlation between absolute error and retention interval, and actual and assigned date, for each subject.

Subject	Median Absolute Error (Days)	Correlation Between Absolute Error and Retention Interval	Correlation Between Actual and Assigned Date	Median Actual Retention Interval
9	24.0	.09	.62 *	566.4
3	83.2	.63 ***	.64 ***	603.3
8	23.7	.49 *	.66 ***	655.5
14	124.1	.29 *	.77 ***	849.7
11	198.5	.33	.62 ***	1262.1
13	65.7	.38 ***	.94 ***	1272.3
6	11.6	.07	.90 ***	1273.8
10	17.1	-.47 *	.93 ***	1282.9
1	58.4	.16	.77 ***	2006.0
4	77.0	-.61 ***	.77 ***	4323.0
2	120.0	-.65 ***	.71 ***	8620.2
Overall	66.0	.14**	.98***	1480.0

Note - Significance levels are for two-tailed tests
* P<.05, ** P<.01, **P<.001

Although the above absolute error analyses do reflect dating accuracy, they do not take into consideration time scale differences. A date can be divided into three components: the year, month, and day of the month. Friedman and Wilkins (1985) found these components to be dated with differing degrees of accuracy. Table 5.11 shows, separately for the remembered and forgotten events, the percentage of events assigned the correct year, correct year and month, and correct year, month and day of the month. Inspection of Table 5.11 suggests that the subjects' ability to determine when an event occurred diminished as the time scale used became more precise. Therefore, the overall absolute error medians reported above reflect mainly the subjects'

inability to determine the month and day of the month when events occurred. It is also particularly interesting that this trend is similar for the remembered and forgotten events.

Table 5.11. The percentage of remembered and forgotten events assigned the correct year, correct year and month, and correct year, month, and day of the month.

Date Components	Percentage Correct Remembered Events	Percentage Correct Forgotten Events	Percentage Correct Overall
	N = 464	N = 150	N= 614
Year	70.9	50.6	65.9
Year and Month	26.9	14.6	23.9
Year, Month, and Day of Month	4.9	1.3	4.2

Overall a significant positive correlation was obtained between absolute error and retention interval (r= .14, $P < .01$) indicating that dating accuracy decreased with increasing retention interval. However, the within-subject correlations between absolute error and retention interval shown in Table 5.10 are somewhat inconsistent with the overall result. While positive correlations were obtained for 8 of the subjects, 4 of these being significant at at least the 0.05 level, significant negative correlations were obtained for 3 subjects (e.g., subjects 4, 10 and 2). The correlation for subject 10 did become positive, but not significantly so, when calculated using only remembered events: the other subject's correlation remained essentially the same. Considering that the overall median absolute error decreased when calculated using only remembered events which suggests forgotten events were dated less accurately, and with reference to Figure 5.3 which shows that subject 4 and 10 generally forgotten recent events rather than remote ones, the negative correlations obtained for these subjects may indicate that their most recent events were dated less accurately because they were forgotten events. Thus overall it is probably fair to conclude that dating accuracy does generally decrease as retention interval increases, particularly if one only considers the dating of events that are remembered.

It has already been noted that overall a slightly smaller median absolute error was obtained when calculated using only the remembered events, which implies event knowledge had an effect on dating accuracy. In order to investigate the possibility that the actual degree of event knowledge, as opposed to just remembering the event, effected dating accuracy; event knowledge was scaled and the relationship between absolute dating error and event knowledge examined.

Using the results of the event aspect cuing procedure, reported in Section 5.2.1, it was relatively easy to scale event knowledge. On the basis of these results four categories of event knowledge were formed. Category one (Recall 1) contains the 151 events that were recalled completely or partially (only one of the remaining aspects correctly recalled) on the basis of one cue only. The 165 events in the second category (Recall 2) were recalled on the basis of two cues. The third category (Recognized) contains 148 recognized events, events recognized or remembered after all three event aspect cues had been presented. The final category (Forgotten) contains the 150 events that the subjects could not remember at all.

It was possible to define event knowledge more precisely by dividing up the events in categories one and two in terms of the event aspect(/s) that had been presented. For example, the results reported in Section 5.2.1 indicate that 'who' was the least efficient cue for recall, therefore events recalled after receiving only this cue might be better remembered than those recalled after hearing a 'what' cue only. Adjusting the knowledge categories in line with the above discussion would, however, have greatly increased the number of event knowledge categories and thus drastically reduced the number of events in some groups. Thus it was decided to adopt the four categories of event knowledge outlined above, as an approximate measure of event knowledge.

Table 5.12 shows the median absolute error and the correlation between assigned and actual date for each event knowledge category. The high correlations between assigned and actual date suggests that dating across the four categories was reasonably accurate. However, examination of the median absolute error of each category shows that dating error increased as event knowledge decreased. Analysis of variance supported this conclusion with a significant main effect of event knowledge category on absolute error (F (3, 610) = 10.606, $p < .0.0001$). An *a posteriori* contrasts using the Scheff'e test revealed

that the three remembered event knowledge categories, Recall 1, Recall 2, and Recognized, were all significantly different ($p < .001$), from the Forgotten category. However, no significant difference between these three categories was found. It appears that how well an event is remembered does not significantly effect dating accuracy, although the absolute error medians shown in Table 5.12 suggest that there is at least a tendency towards more accurate dating as the degree of event knowledge increases.

Table 5.12. Median absolute error and the correlation between assigned and actual date, for each event knowledge category.

Event Knowledge Category	N=	Correlation Between Assigned & Actual Date	Median Absolute Error (Days)
Recall 1	151	.98 ***	37.5
Recall 2	165	.98 ***	41.9
Recognized	148	.99 ***	63.1
Forgotten	150	.98 ***	190.1

Note - Significance levels are for two-tailed tests
* P<0.5, ** P<.01, **P<.001

Further evidence of this was found when the event rehearsal ratings (frequency and recency) were correlated with absolute dating error, $r = -.06$, n. s. and $r = -.10$, $p < .05$, respectively (These correlations were calculated using only the remembered events as no rehearsal ratings were obtained for the forgotten events). Presumably event knowledge would be related to event rehearsal, thus the significant correlation obtained for recency of rehearsal probably indicates that the actual extent of event knowledge affected absolute dating error.

The finding that absolute dating error was significantly greater for the forgotten events is consistent with the explanation given earlier for the significant negative correlations obtained between retention interval and absolute error for subjects 4 and 10. These subjects generally forgot recent events and the above results suggest that dating error for these forgotten events would be greater than for the subjects remembered events. Thus dating error for these subjects would be expected to increase as retention interval decreased.

Absolute error was also compared between the forgotten-similar and forgotten-foreign events, and a significant difference found (F (1, 148) = 3.983, p < 0.05). Examination of the group medians indicates that there was more error associated with the forgotten-similar assigned dates (237 days) than with the forgotten-foreign assigned dates (124.1 days). Inspection of Figure 5.4 which shows the median absolute error of the remembered, forgotten-similar and forgotten-foreign events for subjects that had at least 4 events in each category suggests that the overall absolute error difference between forgotten-similar and forgotten-foreign events is a valid result. Five of the subjects shown in Figure 5.4 dated forgotten-foreign events more accurately than forgotten-similar events. The within-subject results shown in Figure 5.4 also suggest that the overall finding that remembered events were dated more accurately than forgotten events is a valid result: 6 of the subjects show this tendency (Note the difference in median absolute error between the remembered and forgotten-foreign events for subject 6 is .42 of a day, the remembered event absolute error median being the smaller).

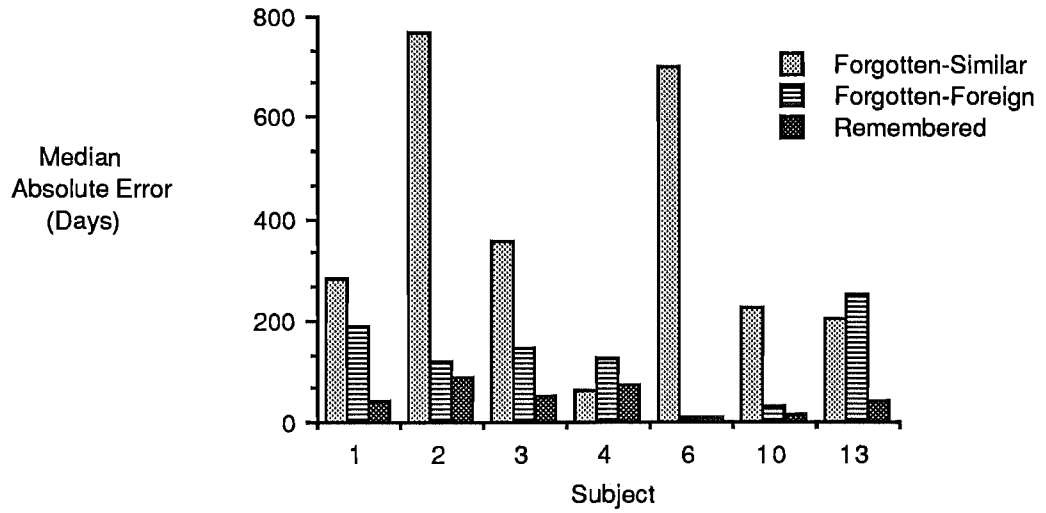

Figure 5.4. Median absolute error (days) for remembered, forgotten-similar and forgotten-foreign events for subjects with at least four events in each category.

5.2.5.2 Dating Accuracy: Signed Error

While absolute dating error gives an indication of overall dating accuracy, it does not reveal the nature of the dating errors or whether dating is biased. Signed error, on the other hand, indicates whether an event was dated more recently or remotely than it actually occurred.

An overall median signed error of + 1.0 day was obtained indicating a very slight tendency towards dating the events more recently than they actually occurred or under-estimating the time elapsed since the event's occurrence. This tendency, however, appears to be only associated with the remembered events, indicated by the zero signed error value (0 days) obtained for the forgotten events. Calculation of the median signed error for the remembered events only (+ 1.0 days) confirmed this.

Table 5.13 shows the median signed error and retention interval, and the correlation between signed error and retention interval, for each subject, as

Subject	Median Signed Error (Days)	Correlation Between Signed Error & Retention Interval	Median Retention Interval (Days)
9	-2.9	.43	566.4
3	9.8	.57 ***	603.3
8	-1.8	.48 *	655.5
14	4.0	.52 ***	849.7
11	35.0	.24	1262.1
13	0.0	.06	1272.3
6	5.4	.04	1273.0
10	4.7	.09	1282.9
1	6.5	.12	2006.0
4	-52.1	.74 ***	4323.0
2	-10.9	.44 *	8620.2
Overall	1.0	-.08 *	1480.0

Note - Significance levels are for two-tailed tests
*P<.05, **P<.01, ***P<.001

Table 5.13. Median signed error, median retention interval, and the correlation between signed error and retention interval, for each subject.

well as the overall correlation between signed error and retention interval (Both remembered and forgotten events are included in the table, and results are ranked according to median retention interval). Examination of the within-subject median signed errors shown in Table 5.13 indicates that 10 of the subjects did show a dating bias. Furthermore, the dating bias for 6 of the subjects is positive, suggesting the overall positive median signed error value is a reasonably valid result.

As noted in Chapter 1, some studies (e.g., Ferguson & Martin, 1983; Kemp, 1988; Lieury, Caplain, Jacquet & Jolivet, 1979; Lieury, Aiello, Lepreux & Mellet, 1980; Loftus & Marburger,1983) have found that retention interval affects the nature of dating errors with recent events being dated too remotely and remote events being dated too recently. Evidence of this type of relationship between signed error and retention interval in the present study was found when the logarithm of assigned date was regressed on the logarithm of actual event date. The obtained exponent of .96 and correlation of .98 indicating that the remotest events were dated too recently and the most recent events too remotely. The eleven positive within-subject correlations between signed error and retention interval shown in Table 5.13 are further evidence of this type of relationship between signed error and retention interval, indicating that all the subjects tended to date their events more recently as retention interval increased.

However, the overall significant negative correlation between signed error and retention interval shown in Table 5.13 is not consistent with the within-subject correlations. It appears the overall result is rather misleading, it is in fact the result of between-subject retention interval differences. As shown in Table 5.12 the two subjects that dated the oldest events (e.g., subject 2 and 4) both have negative median signed errors, thus the overall negative correlation between retention interval and signed error is an artifact of these two subjects responses.

For the subjects with a negative median signed error (e.g. subjects 9, 8, 4, and 2) the positive correlation between signed error and retention interval probably indicates a tendency for the extent to which an event was dated too remotely to decrease as retention interval increased. The correlations between absolute error and retention interval for subjects 4 and 2 ($r = -.61$, $p < .001$ and $r = -.65$, $p < .001$, respectively) shown in Table 5.10, support this suggestion;

indicating that for these two subjects dating error decreased as retention interval increased.

As noted in Chapter 1, section 1.3.3 Brown, Rips & Shevell (1985) proposed an event memory explianation of systematic dating errors, the accessibility hypothesis. In order to investigate whether event memory could account for the relationship between retention interval and signed error in this study, signed error was compared across the four event knowledge categories defined earlier (Recall 1, Recall 2, Recognized, and Forgotten). Table 5.14 shows the median signed error for each event knowledge category, examination of the table suggests that their was a tendency for the better remembered events to be dated more recently. However, analysis of variance indicated that the between category differences are not significant ($F(3,610)=0.499$, n.s.).

Event Knowledge Category	N=	Median Signed Error (Days)
Recall 1	151	1.0
Recall 2	165	2.9
Recognized	148	0.0
Forgotten	150	0.0

Table 5.14. Median signed error for each event knowledge category.

The validity of the above results can be questioned on the basis of the finding that signed error varied somewhat between subjects, and the possibility that, for example, knowledge category Recall 1 contained subjects who had positive median signed errors, and knowledge category Recognized contained subjects who had negative median signed errors. However, the results reported in Sections 5.2.1, 5.2.2 and 5.2.3 generally show that the subjects were similar in terms their event memory. That is, there is no reason to suspect that any one of the four knowledge categories contains more events from one subject than another.

The data was also examined for evidence of boundary effects consistent with the models of Huttenlocher, Hedges and Prohaska (1988), and Rubin and

Baddeley (1989). The period cover by a subject's submitted diaries was assumed to define a boundary, for example, subject 1 submitted diary material covering the years 1981 to 1984, thus the beginning of 1981 and end of 1984 defined the early and late boundary markers for this subject. Figure 5.5 shows a graphical representation of the boundary markers for each subject. Also shown is the earliest and latest date response made by each subject. Inspection of Figure 5.5 indicates that 9 of the subjects dated all their events within their boundary markers. Subject 1 and subject 13, on the other hand, dated 10 and 2.6 percent of their events outside their early boundary respectively. However, it seems reasonable to conclude that generally the subjects assigned dates to their events which were within the boundaries defined by their submitted diary material.

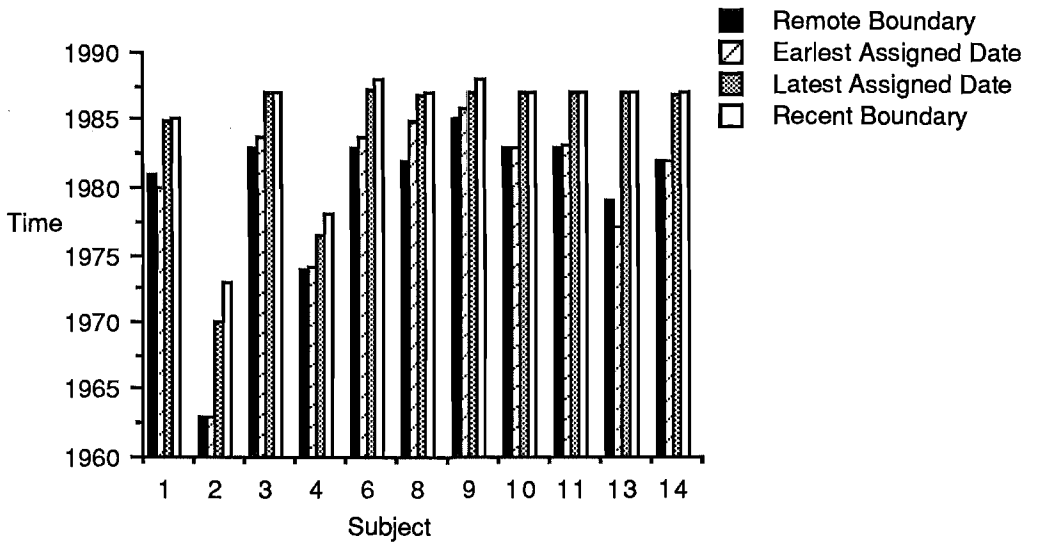

Figure 5.5. Boundaries defined by subjects submitted diary material, and the earliest and latest date each subject assigned to their events.

Figure 5.5 suggests that dating errors for events near each end of a subject's boundary markers must have been in the direction of the median actual date of their events. That is, signed dating errors for the recent events must have been generally negative and signed dating errors for remote events generally positive. Furthermore, the finding that absolute dating error generally increased as retention interval increased suggests that there was more dating error for remote events, more positive signed errors, which is what the overall positive signed error value reflects. Overall, a boundary effects explanation seems to adequately account for the signed error results obtained in this study.

5.2.6 Dating Strategies

In this section the strategies that the subjects claimed to have adopted when generating a date response are examined. For this part of the analysis the data set was further reduced by the exclusion of subjects 1 and 2. These two subjects were the first to participate in the study and gave only one dating strategy response for each date. The other subjects, by contrast, indicated their adopted dating strategy for each component of a date response. That is, they indicated how they generated the year, month, and day of the month separately. Five-hundred and eleven events were dated by the 9 remaining subjects.

The 'generative mechanism for dating' card (shown in Figure 4.5, Chapter 4) contained five defined dating strategies (i.e., remembered, guessed, reconstructed using before event landmark events, reconstructed using after event landmark events, and reconstructed using information from the event aspect cues presented). The subject's indication of which dating strategy or combination of dating strategies defined on the card best described how they generated each date component resulted in ten different dating strategies being defined.

Table 5.15 shows, separately for each date component, the percentage of events that were dated using each of the 10 dating strategies. Inspection of Table 5.15 indicates that a number of the dating strategies (e.g., strategies 6, 7, and 10) were not used very frequently. Strategies 6 and 7 both involve the use of landmark events but subjects were not very confident about their use as they indicated the date produced was also something of a guess. The low frequency of use of these dating strategies suggests that subjects only use landmark events to date events when they are reasonably confident they will enhance the date response given. Strategy 10, the other dating strategy not used very frequently, involved the use of a before event landmark event and information contained in the event description, this result suggests that subjects prefer to use either a landmark event or target event information but not both simultaneously when dating an event. The fact that no subject indicated he or she used an after event landmark event and information contained in the event description to produce a date component is further evidence that landmark events and event description information were not used in conjunction when generating date components (as no subject used this strategy it is not included in Table 5.15).

Table 5.15. The percentage of events dated using each of the ten dating strategies defined by the subjects for each date component.

Dating Strategy	Year	Month	Day of the month
(1) Remembered	37.7	9.3	3.7
(2) Guessed	9.9	40.1	85.1
Reconstructed using:			
(3) Before event landmark events	3.7	5.6	.5
(4) After event landmark events	8.4	5.2	2.1
(5) Target event cue information	18.1	27.2	5.4
(6) Before event landmark & guess	.3	.7	.1
(7) After event landmark & guess	.5	2.1	.7
(8) Event cue information & guess	4.3	3.3	.7
(9) Before & after event landmark	16.0	5.6	.7
(10) Before event landmark & cue information	.5	.3	.3
All reconstruction combined	52.2	50.5	11.1

Examination of the distribution of dating strategies across date components shown in Table 5.15 indicates that remembering date components decreased as the time scale being defined became more precise, that is decreased progressively from year to month to day of the month. Guessing, by contrast, shows the opposite pattern, increasing progressively as the time scale became more precise. The pooled reconstructive strategy figures (strategies 3 to 10 combined), also shown in Table 5.15, suggest that the date components year and month were equally likely to be reconstructed whereas the day of the month component was not frequently reconstructed. When considered together the distributions of the dating strategies also suggests that when recall fails, the adopted strategy depends on the date component being generated. Guessing appears to be the favoured alternative for the day of the month component, and reconstruction for the year component, while the month component appears to be roughly equally guessed and reconstructed.

The dating strategies adopted by each subject for each date component are shown in Table 5.16, listed in order of median retention interval. Only the pooled reconstructive strategy figures (strategies 3 to 10 combined) are presented in order to make the table more readily interpretable. Examination of Table 5.16 suggests that the overall date component dating strategy

differences outlined above are valid as the overall tendencies are evident and reasonably consistent at the within-subject level.

Subject	Number of Dated Events	Remembered	Guessed	All Reconstructive Strategies	Median Retention Interval (Days)
		Year	Component		
9	20	55.0	10.0	35.0	566.4
3	72	55.5	25.0	19.5	603.3
8	22	68.1	0	31.9	655.5
14	63	14.2	4.7	81.1	849.7
11	22	18.2	0	81.8	1262.1
13	188	47.3	10.1	42.6	1272.3
6	28	42.8	17.8	39.4	1273.0
10	19	63.1	15.8	21.1	1282.9
4	77	1.3	1.3	97.4	4323.0
		Month	Component		
		10.0	25.0	65.0	
		8.3	48.6	43.1	
		31.8	27.2	41.0	
		1.6	50.8	47.6	
		9.0	31.8	59.2	
		11.7	43.6	44.7	
		14.3	17.8	67.9	
		15.7	26.3	58.0	
		1.3	36.3	62.4	
		Day of the	Month Component		
		10.0	80.0	10.0	
		1.4	91.7	6.9	
		0	91.0	9.0	
		1.6	76.2	22.2	
		9.0	86.4	4.6	
		4.8	81.9	13.3	
		7.1	89.3	3.6	
		5.3	73.5	21.2	
		1.3	94.8	3.9	

Table 5.16. The dating strategies adopted by each subject for each date component.

5.2.6.1 Retention Interval Effects on Dating Strategies

The dated events were divided into six groups on the basis of retention interval; subject 4 was excluded from this analysis because the median retention interval for this subject was substantially different from that of the other 8 subjects (see Table 5.16). Table 5.17 shows the retention interval range and the number of events dated in each group. Also shown, separately for the three date components, is the percentage of events whose date was remembered, guessed, and reconstructed (reconstructive strategies 3 to 10 combined) within each retention interval group.

Retention Interval Blocks (years)	N= Dated Events	Remembered Date	Guessed Date	Reconstructed Date
		Year	Component	
.62 - 1.999	127	59.0	12.5	28.5
2.000 - 2.999	110	51.8	9.0	39.2
3.000 - 3.999	60	41.6	6.6	51.8
4.000 - 4.999	52	23.0	15.3	61.7
5.000 - 5.999	41	36.5	9.7	53.8
6.000 - 8.999	44	18.1	18.1	63.8
		Month	Component	
		15.7	35.4	48.9
		14.5	36.3	49.2
		11.6	40.3	48.1
		3.8	38.4	57.8
		4.8	48.7	46.5
		0	70.4	29.6
		Day of the	Month Component	
		7.0	77.1	15.9
		3.6	87.2	9.2
		5.0	80.0	15.0
		1.9	90.3	7.8
		2.4	82.9	14.7
		0	88.6	11.4

Table 5.17. Percentage of events dated by dating strategy by retention interval for each date component.

Examination of Table 5.17 suggests that the time since an event's occurrence had an effect on the strategy used to generate a date component. There appears to be more actual remembering of date components as the time since the event's occurrence decreased, and more guessing as retention interval increased; tendencies which seem to be reasonably consistent across all three date components. Similarly date reconstruction of the year component appears to have increased as retention interval increased. However, date reconstruction of the month and day of the month components does not appear to be affected by retention interval.

The apparent effect of retention interval on dating strategy adoption could of course reflect between subject differences, as the subjects did vary somewhat in terms of retention interval. However, examination of the within-subject results shown in Table 5.16, which as noted are ranked according to median retention interval, indicates no systematic changes in dating strategy adoption which might account for the retention interval analysis results. That is, for example, the increase in year component reconstruction as retention interval increased observed in Table 5.17, is not evident in Table 5.16.

5.2.6.2 Event Knowledge Effects on Dating Strategies

Using the procedure described in Section 5.2.5, the events were divided into four knowledge groups. Table 5.18 shows, separately for each date component, the percentage of events within each event knowledge group whose date was remembered, guessed and reconstructed (reconstructive strategies 3 to 10 combined). The most striking aspect of Table 5.18 is that the date components for a number of events, particularly the year component, were remembered even when the actual event being dated was not remembered. One possible explanation for this might be that some aspect of an event, such as the 'where' cue, tied it to a specific point in time, and although the subject could not remember the event, they knew when it must have occurred.

Inspection of the percentage of date components stated as being remembered across the event knowledge groups suggests that remembering date information increased as event memory increased. Examination of the percentages confirmed this for all three date components, $X^2(3, \underline{N}= 511) = 26.55$,

P< .01, $X^2(3, N= 511) = 19.17$, P<.01 and $X^2(3, N= 511) = 9.02$, P< .05 for the year, month and day of the month components respectively.

Furthermore, when event memory was relatively strong but the date components could not be remembered, the subjects appear to have adopted a reconstructive strategy when giving a response, rather than simply guessing. In order to examine this further, the four knowledge groups were combined into two; Recall 1 and 2 being combined, and Recognized and Forgotten being treated similarly. Examination of the proportion of date components stated as

Table 5.18. Percentage of events dated in each event knowledge category by dating strategy for each date component.

Event Knowledge Category	N= Dated Events	Remembered Date	Guessed Date	Reconstructed Date
		Year Component		
Recall 1	134	47.7	5.2	47.1
Recall 2	131	51.1	3.8	45.1
Recognized	119	34.4	9.2	56.4
Forgotten	127	15.7	22.0	62.3
		Month Component		
		14.1	29.8	56.1
		15.2	31.2	53.6
		6.7	48.7	44.6
		.7	51.9	47.4
		Day of the Month Component		
		7.4	76.8	15.8
		3.8	80.9	15.3
		2.5	89.0	8.5
		.7	94.4	4.9

guessed performed for each date component found that for all three components significantly (P<.01) more date components were guessed for the recognized/forgotten events, Z=4.52, Z=4.65 and Z=4.19 for the year, month and day of the month respectively. A similar analysis on the proportion of date components stated as reconstructed confirmed that for the month (Z=2.04,

P< .05) and day of the month (Z=3.33, P< .01) significantly more Recall 1/2 event date components were reconstructed. The year component, however, appears to show the opposite tendency, with year of occurrence reconstruction increasing as event knowledge decreased (Z= 3.02, P< .01).

The apparent relationship between dating strategy adoption and event knowledge may account for the decrease in remembering and increase in guessing of the month, and day of the month date components as retention interval increases. Furthermore, the increase in year component reconstruction as event knowledge decreased is consistent with the observed tendency for year component reconstruction to increase as retention interval increased.

5.2.7 Events Dated Exactly

The events that were dated exactly have some theoretical importance in that they may represent landmark events or events that provide temporal reference points. Twenty-five events were dated exactly, the subjects indicating they remembered the year, month, and day of the month, 21, 14, and 12 times, respectively. There is, therefore, some support for the suggestion that these events may be temporal reference points. However, the number of remembered date components is somewhat less than the overall number of events dated exactly, thus date components for some of the exactly dated events were not actually remembered by the subjects. It also appears that the number of date components actually remembered decreased as the date component became more precise, that is from year to month to day of the month.

The number, and categorization label, of events that were exactly dated are shown in Table 5.19, as are a number of unsolicited responses that subjects made when dating these events. Comparison of the event categorization labels and the subject's responses when dating the events suggest that the former do not adequately describe landmark events. Rather it would appear that birthdays and public holidays are the types of event for which one might have a temporal reference point.

Inspection of the Table 5.19 indicates that no single type of event stands out as being particularly applicable to exact dating. The percentage of some of the types of events that were exactly dated is reasonably high, however, the

actual number of these types of events was very low. For example, only one event was categorized 'Tramp/walk' and one event categorized 'Flying', and both of these events were dated exactly.

The number of events each subject dated exactly varied from 0 to 8, with 11 of the subjects managing to date at least 1 event exactly. It is particularly interesting to note that two events which where rated as forgotten-similar were actually dated exactly, these events are shown by an * in Table 5.19. For one of these events the subjects response at the time of dating (that shown in Table 5.19) might indicate why it was exactly dated and why it was forgotten similar.

Table 5.19. The number and types of event exactly dated, and responses some subjects made when dating these events.

Event Type	Number of Exactly Dated Events	Subject Responses
Restaurant	2	Friends birthday, Own birthday
Retail purchase	1	
Attending movie/theatre	7	Waitangi Day, New Years Eve, First date with long time friend, Own birthday, Mothers birthday
Party	1*	Friends birthday
Saw Band/ Orchestra	1	New Years Eve
Received present	1	
Canoeing	1	
Picked something up/organized	1	
Sking	1	Waitangi day
Public performance	1	
Cabera	1	
Swimming	1*	
Field trip	1	First meeting with long time friend
Car broke down	1	Mothers birthday
Drinks out/ hotel	1	
Lost something	1	Friends birthday
Flying	1	
Horseriding	1	Friends birthday
Tramp/walk	1	

Note - * indicates the event was rated as forgotten-similar.

The subjects response suggests it was a friends birthday party, while the exact date suggests the subject knows the date of the friends birthday. Furthermore, it was perhaps a forgotten-similar event because it was one of many birthday parties the friend had had and which the subject had attended.

5.3 Experiment 6, Part B: Duration Events - Results and Discussion

The 14 subjects responded to a total of 187 duration questions. Actual event duration ranged from 3 to 550 days with a median actual duration of 9 days. Estimated event duration ranged from 2 to 700 days with a median estimated duration of 10 days. Seventeen of the events were not remembered by the subjects, indicated by being given a '1' rating on the knowledge scale. The mean overall knowledge rating was 3.7, a '3' rating being defined as 'I remember it but not so well', and a '4' rating as 'I remember it fairly well'.

Table 5.20 shows the median actual duration, median estimated duration, median absolute error and median signed error, and the correlation between actual and estimated duration for each subject, and overall (error scores were calculated by subtracting actual event duration from estimated event duration, in the case of absolute error the sign of the error was ignored).

Subject	Number of Duration Events	Median Actual Duration (Days)	Median Estimated Duration (Days)	Median Absolute Error (Days)	Median Signed Error (Days)	Correlation Between Actual & Estimated Duration
1	17	16.0	21.0	4.0	1.0	.46
2	11	22.0	14.0	7.0	0	.25
3	16	7.0	11.0	5.0	2.5	.94***
4	20	9.0	10.0	3.5	.5	.50*
5	6	4.0	5.0	2.0	-1.0	.96**
6	5	8.0	5.0	7.0	-2.0	.75
7	7	4.0	4.0	1.0	0	.97***
8	5	4.0	5.0	1.0	1.0	.66
9	7	36.0	60.0	5.0	4.0	.97***
10	5	26.0	14.0	6.0	-1.0	.86
11	4	5.5	6.0	2.5	-1.0	.97*
12	9	5.0	4.0	2.0	-1.0	.47
13	49	9.0	14.0	9.0	1.0	.92***
14	26	10.0	7.0	1.5	0	.82***
Overall	187	9.0	10.0	4.0	0	.85***

Note - Significance levels are for two-tailed tests
*P<.05, **P<.01, ***P<.001

Table 5.20. Median actual duration, median estimated duration, median absolute error and median signed error, and the correlation between actual and estimated duration, for each subject.

Inspection of the within-subject correlations between actual and estimated event duration shown in Table 5.20 suggests that all the subjects were reasonably capable of estimating the duration of their events. The within-subject correlations are also reasonably consistent with the overall correlation obtained between actual and estimated duration ($r = .85$, $p < .001$) and suggest that the overall result is valid. Further evidence of the subject's ability to estimate event duration is seen in the error scores shown in Table 5.20. Overall estimates were in error by only 4 days (absolute error), while the signed error median of 0 days indicates no overall tendency to either over- or under-estimate event duration. Furthermore, inspection of the within-subject median absolute and signed errors indicates both values are generally quite close to the overall values which suggests the overall results are a valid representation.

Table 5.21 shows the median actual duration, median estimated duration, median absolute error, median signed error and mean knowledge rating for each type of event within the filled and empty duration event categories. Inspection of Table 5.21 indicates that the overall median actual and median estimated event duration are identical for both the filled and empty duration events. These results are further evidence of the subject's ability to estimate event duration, and also suggests that the type of event being estimated did not have a marked effect on the accuracy of the estimate provided.

Further evidence of an overall similarity in the accuracy of the estimates provided for the filled and empty duration events was found when actual and estimated duration were correlated: $r = .74$, $P < .001$ and $r = .93$, $P < .001$ for the filled and empty duration events respectively. These two correlations are similar to the overall correlation between actual and estimated duration reported above and provide further evidence that the different types of event did not produce markedly different duration estimations. These correlations also suggest that estimated duration increased as actual duration increased, a trend which is evident in both Table 5.20 and 5.21.

Event Type	N=	Median Actual Duration (Days)	Median Estimate Duration (Days)	Median Absolute Error (Days)	Median Signed Error (Days)	Mean Knowledge Rating
Filled Duration Events						
Friend/s come to stay	8	3.5	4.0	1.0	-1.0	2.6
Official trip	16	3.5	4.0	0.0	0.0	4.4
Holiday	49	7.0	10.0	2.0	0.0	4.0
Acted in play	2	8.0	14.0	3.0	3.0	2.5
Hospitalized	5	11.0	5.0	5.0	-5.0	3.8
Employed in job	8	17.5	15.0	8.5	6.0	5.0
Medical treatment	4	25.5	51.0	81.5	11.0	5.2
Have a pet	5	30.0	30.0	20.0	0.0	4.0
Take course	10	47.5	56.0	13.0	9.0	4.3
Construct something	6	55.5	14.0	33.5	-18.5	2.6
Relationship	1*	170.0	150.0	20.0	-20.0	6.0
Overall	114	7.0	7.0	2.0	0.0	4.2
Empty Duration Events						
Have something done - have it redone	3	5.0	3.0	2.0	0.0	4.3
Receive invitation -attend	13	7.0	14.0	8.0	4.0	3.5
Buy something - pick it up	15	9.0	9.0	5.0	.5	2.9
Friend /relative goes away - returns	7	12.0	10.0	2.0	-2.0	3.1
Sit test - get result	3	12.0	14.0	2.0	1.0	3.6
Loose something - find it	8	13.0	21.0	12.0	2.0	3.3
See a movie - see it again	2	14.0	5.5	9.5	-8.5	4.5
Apply for position - hear result	12	14.5	20.5	9.5	3.0	3.8
Order something by mail - receive it	3	38.0	30.0	6.5	-3.5	2.6
Photograph taken - view it	3	58.0	60.0	3.0	2.0	4.0
Buy concert ticket - attend	3	86.0	42.0	22.0	4.0	3.6
Finish course - start related course	1*	91.0	7.0	84.0	-84.0	1.0
Overall	73	14.0	14.0	7.0	1.0	3.7

Note- * Indicates table values are actual rather than median or mean

Table 5.21. Median actual duration, median estimated duration, median absolute error, median signed error, and mean knowledge rating for each type of event within the filled and empty duration event categories.

In order to examine the relationship between estimated and actual event duration, the logarithm of the duration estimates was regressed on the logarithm of actual event duration. An exponent of .87 and a correlation of .81 were obtained, indicating a tendency to overestimate short and underestimate long duration events. Similar exponents (.88 and .85) and correlations (.84 and

.75) were obtained when the analysis was performed using only the filled and empty duration events respectively. Furthermore, the obtained exponents are very similar to the .90 typically found in traditional duration estimation research (e.g., Eisler, 1976), in which markedly shorter actual durations (less than one minute) are generally used.

Within-subject regression analysis results are shown in Table 5.22, as are the within -subject correlations between retention interval and actual event duration, retention interval and estimated event duration, and knowledge

Subject	Number of Duration Events	Correlation Between Retention Interval & Actual Duration	Correlation Between Retention Interval & Estimated Duration	Correlation Between Knowledge Ratings & Estimated Duration. (Remembered Events Only)	Correlation Between Log-Actual Duration & Log-Estimated Duration	Regression Exponent
1	17	.53*	.48*	.64**	.85	.77
2	11	.06	.21	. 14	.70	.83
3	16	-.02	.01	-.00	.85	.89
4	20	.34	.26	.24	.69	.81
5	6					
6	5					
7	7	.06	.05	.15	.98	.91
8	5					
9	7	-.47	-.48	-.76*	.97	.92
10	5					
11	4					
12	9	-.05	-.03	.72*	.80	.87
13	49	.08	.02	.07	.77	.96
14	26	-.08	-.14	-.40*	.87	.96
Overall		.09	.03	.05	.81	.87

Note - Significance levels are for two-tailed tests
*P<.05, **P<.01, ***P<.001

Table 5.22. Within-subject correlations between retention interval and actual event duration, retention interval and estimated event duration and knowledge ratings and estimated event duration; and regression analysis results.

ratings and estimated event duration for subjects with at least 7 duration events. Examination of the within-subject regression analysis results suggests that the overall result is reasonably valid, with most subject's exponents and

correlations indicating a tendency towards over- and under-estimation of short and long duration events respectively.

5.3.1 Ornstein's (1969) 'Storage Size" Hypothesis

Further analyses were performed in order to examine Ornstein's (1969) 'storage size' hypothesis. Retention interval (the time between the beginning of an event and the interview date) which ranged from 222 days to almost 25 years (median 3.7 years), was not significantly correlated with either actual event duration ($r = .09$) or estimated event duration ($r = .03$). The latter result is inconsistent with Ornstein's model which predicts an inverse relationship between retention interval and estimated duration based on the assumption that storage size decreases over time (memory trace decay). The result is, however, similar to that obtained in Experiment 2, Chapter 2; as is the finding of no relationship between retention interval and actual duration, which largely rules out the possibility that the nonsignificant correlation between retention interval and estimated duration resulted because the older events were actually of long duration and the recent events of short duration.

The within-subject correlations between retention interval and estimated and actual event duration shown in Table 5.22 generally support the validity of the overall results. Subject 1 does have a significant correlation between retention interval and estimated duration, but the correlation between retention interval and actual duration is also significant for this subject, which makes the former correlation rather suspect.

Ornstein's prediction is, as noted, based on the assumption that storage size decreases over time. The negative correlation between retention interval and knowledge ratings ($r = -.09$) was, however, not significant; which raises the possibility that Ornstein's predicted relationship between retention interval and duration estimation may not have been found because 'storage size' (event memory) did not significantly decreased with retention interval.

The knowledge ratings did, however, vary between events; with 17, 21, 37, 53, 35, 19, and 5 events being given knowledge ratings of 1, 2, 3, 4, 5, 6, and 7 respectively. Thus it was possible to use the knowledge ratings to investigate Ornstein's 'storage size' hypothesis. The 17 events that the subjects could not remember (those given a 1 rating on the knowledge scale) were

excluded from these analyses. Knowledge ratings and estimated duration were found to be uncorrelated for the remaining 170 events ($r = .05$, n.s.). Thus, contrary to Ornstein's prediction, the better remembered events were not estimated to have lasted longer.

The possibility that a relationship between knowledge ratings and estimated duration was not found because the better remembered events were actually shorter in duration and the less well remembered events actually longer can be discounted, as the correlation between the knowledge ratings and actual event duration ($r = -.01$) was not significant.

Within-subject analyses were performed to determine the validity of the group results. As noted, Table 5.22 shows the within subject correlations between knowledge ratings and estimated event duration Inspection of Table 5.22 indicates that two significant positive correlations were obtained between knowledge ratings and estimated duration i.e., $r = .64$, $p < .01$ for subject 1 and $r = .72$, $p < .05$ for subject 12. The significant correlation obtained for subject 12 might, however, be an artifact of a relationship between knowledge ratings and actual event duration as these two variables were significantly correlated for this subject ($r = .77$, $p < .05$). No significant correlations were obtained between knowledge ratings and actual event duration for the other 13 subjects. Overall the within-subject correlations between knowledge ratings and estimated event duration are reasonably consistent with the overall result.

Rehearsal ratings, frequency and recency, which were both found to be positively correlated to knowledge ratings, $r = .57$, $p < .001$ and $r = .49$, $p < .001$ respectively, were also correlated with estimated event duration (events given a '1' knowledge rating were excluded from these analyses as they were not rated on the rehearsal scales). The obtained non-significant correlations, $r = .05$ for frequency and $r = .04$ for recency, provide further evidence that estimated event duration was not related to event knowledge. Furthermore, no significant correlations were obtained between the rehearsal ratings and actual event duration suggesting the above results are not a reflection of the short duration events being given larger rehearsal ratings and the longer duration events smaller ratings.

Comparison of the knowledge ratings of the filled and empty duration events (remembered events only) indicated that they were significantly

different (F (1, 168) = 6.570, p < .01). The filled duration events were on average given a higher knowledge rating (4.24) than the empty duration events (3.73), which is not unexpected as filled duration events by definition contain more associated information. Furthermore, examination of Table 5.23, which shows the filled and empty duration event mean knowledge rating for each subject, suggests that the observed overall mean knowledge rating difference between the filled and empty duration events is a reasonably valid result. In ten of the twelve cases where a comparison could be made, the filled duration events received a higher average knowledge rating. These results suggest that comparing the duration estimates of the filled and empty duration events would provide another means of testing Ornstein's model.

Subject	N= Filled Duration Events	N= Empty Duration Events	Filled Duration: Mean Knowledge Rating	Empty Duration: Mean Knowledge Rating
1	11	6	4.6	4.5
2	11	-	3.9	-
3	10	4	5.2	3.0
4	6	9	4.3	4.0
5	4	2	5.0	3.5
6	3	2	4.3	3.0
7	5	2	3.6	4.0
8	-	5	-	5.2
9	3	4	6.3	4.5
10	1	3	5.0*	3.6
11	3	1	4.3	3.0*
12	6	2	3.3	4.0
13	25	19	3.7	3.1
14	18	7	4.1	3.5
Overall	106	66	4.2	3.7

Note- * indicates actual knowledge rating, not mean.

Table 5.23. Number of filled and empty duration events, and mean knowledge rating for each subject (only remembered events are included).

Analysis of covariance, with actual event duration as the covariate, was used to compare the filled and empty duration event estimates (this procedure adjusted for between-group actual event duration differences and in doing so produced a dependent variable which reflected both signed error and estimated

duration characteristics). The obtained non-significant result (F (2, 167) = 0.128, n.s.) is consistent with those reported earlier in that the better remembered events (the filled duration events) were not estimated to have lasted longer. Furthermore, this result is inconsistent with the results of traditional duration estimation research on the filled-duration illusion, which has generally found filled duration intervals to be estimated significantly longer than unfilled or empty intervals of equal actual duration (e.g., Buffardi, 1971; Burnside, 1971; Frankenhaeuser, 1959; Fraisse, 1963; Hall & Jastrow, 1886; Ornstein, 1969; Poynter & Homa, 1983; Roeloefs & Zeeman, 1951; Schiffman & Bobko, 1977; Thomas & Brown, 1974); a result which is frequently explained using Ornstein's 'storage size' model.

The relationship between event knowledge and duration estimation was also investigated by examining the effect of the order in which the subjects gave the knowledge rating and duration estimate. As noted in Chapter 4, section 4.5, this order was randomly assigned across events. It is probable that, in giving a knowledge rating for an event, the subject actively searched memory for the relevant information. Therefore, when the subject was required to give a duration estimate after a knowledge rating, it might be expected that the estimate would be based on more information than when the estimate was given first.

The events were divided into two groups according to whether the duration estimate was given before or after the knowledge rating (events given a '1' knowledge rating were excluded). Duration estimates between the groups of events were compared using analysis of covariance with actual event duration as the covariate. In line with the preceding results, no significant difference was found between the two groups (F (2, 167) = 3.693, n. s.).

The preceding analyses, as noted, used only the remembered events. In order to examine the estimates of the 'forgotten' events, those given a '1' knowledge rating, and as a further test of Ornstein's model, the events were divided into three groups on the basis of event knowledge. Group one contained events given a 5 to 7 rating on the knowledge scale (N=59), group two events given a 2 to 4 rating (N=111), and group three events given a 1 rating (N=17). Estimated event duration was compared between the groups using analysis of covariance with actual event duration as the covariate. Again no indication that event knowledge was positively related to estimated event

duration was found (F (3, 184) = 2.458, n.s.). In particular, the finding that the duration estimates of the forgotten events (group 3) were not significantly different from the remembered event estimates (groups 1 and 2) argues against an effect of event knowledge on the length of an event's estimated duration.

5.3.2 Duration Estimation Accuracy

The above analyses found little evidence of Ornstein's predicted positive relationship between event knowledge and estimated event duration. These analyses did not, however, address the question of whether duration estimation accuracy was related to event knowledge. Estimation error (absolute) was therefore compared using analysis of covariance, with actual duration as the covariate, between the knowledge rating/estimate and estimate/knowledge rating groups defined earlier (F (2, 167) = 3.80, n.s.), the filled and empty duration events (F (2, 167) = 0.074, n.s.), and the three event knowledge groups defined above (F (3, 183) = 0.312, n.s.). All of the analyses produced non-significant results and are consistent with the non-significant correlation obtained between the knowledge ratings and absolute error scores (r = -.06). These results suggest that duration estimation accuracy is also not significantly related to event knowledge.

5.3.3 Conclusion

The overall finding that event knowledge does not affect the estimated duration of a personally experienced event suggests that the subjects may have simply guessed the durations. However, the relationship between actual and estimated duration, and the more than reasonable degree of estimation accuracy achieved by the subjects, argues strongly against this conclusion. Indeed, the subjects estimated the duration of 15.5 percent of the events exactly. Furthermore, the finding that the duration estimates for the forgotten events were not significantly different, in terms of absolute error, to the remembered event estimates is similar to that observed in Experiment 2. Overall these results suggests that the reconstructive model of duration estimation, proposed to account for the results obtained in Experiments 2 and 4, may also adequately explain the results obtained in this experiment.

No aspect of the obtained results suggest that another explanation of the retrospective duration estimation of autobiographical events is necessary. The

lack of an event knowledge effect on estimation accuracy (absolute error), which is in contrast to that observed in Experiment 2, is probably due to the subjects in this experiment having actually experienced the events. Thus, the advantage of actually remembering a specific event, in terms of duration estimation accuracy, observed in Experiment 2, was probably always available in this experiment. Finally, it is difficult to imagine why the processes involved in the estimation of autobiographical event duration should be different from those involved in the estimation of public event duration.

CHAPTER 6

GENERAL DISCUSSION

6.0 Introduction

This chapter is divided into five sections. First, the undirected diary method is discussed. This section focuses on the potential of the research method and its use in this research. The second section deals with Experiment 6, Part a; specifically, the results relating to the remembering and forgetting of the spontaneous autobiographical events. These results are examined in relation to other research, and as a basis for theorizing about the nature (organization) of autobiographical memory. The third section also discusses the results of Experiment 6, Part a; those relating to event dating. A reconstructive model of event dating is outlined and factors relating to event dating research in general discussed. Section four discusses retrospective duration estimation. Ornstein's (1969) storage size hypothesis is examined in relation to the results obtained in Experiments 1 through 4, and Experiment 6, Part b; and the reconstructive model of duration estimation outlined in Chapter 2 is discussed. The effect of ecological validity on duration estimation, and the relationship between event dating and duration estimation is also examined in this section. Finally, the implcations of this research for retrospective recall are discussed.

6.1 The Undirected-Diary Method

The undirected-diary method, as noted in Chapter 3, overcomes some of the problems associated with conducting ecologically valid memory research. The number of diarists that participated in Experiment 6, in contrast to Angell and Freedman's (1953) suggestion, allowed the development of scientific generalizations. Further support for the generalizability of the results obtained using the undirected-diary method was found in the results of Experiment 5. The majority of the student sample were or had been diarists, and overall, diarists did not appear to be a special subgroup.

Experiment 6, Part a, attempted to replicate some of the findings of Wagenaar (1986) relating to the recall of autobiographical event information,

and the findings of a number of studies on event dating (e.g., Thompson, 1982, 1985b). The fact that Wagenaar's results were replicated, and event dating results consistent with those found in other studies were obtained, both overall, and at the level of within-subject analyses (see Sections 6.2. to 6.3.4), is further evidence in support of the reliability of the results, and suggests the undirected-diary method is a valid way to assess autobiographical memory.

Furthermore, the undirected-diary method in relation to the main objective of this study, - an examination of retrospective duration estimation under ecologically valid conditions - proved particularly useful. It is hard to imagine how verifiable data on events such as the empty duration events used in Experiment 6, Part b, could have been otherwise obtained. Admittedly, the diary method, as described in Chapter 3 Table 3.1 Section 1, could have been used, but considering I found only 187 duration events in 48 years of diary records, employing this method would probably have involved unrealistic delays. Furthermore, such delays could not be avoided by having a large sample record events over a short period. Although a number of duration events would undoubtedly have been recorded, knowledge ratings between the events would probably not have varied sufficiently to provide an adequate test of Ornstein's (1969) storage size hypothesis (see Section 6.4.1 for further discussion of duration event knowledge ratings).

The general consistency of the within-subject analyses in both Parts a and b of Experiment 6 suggests that the fact that each subject's interview schedule contained some events which were unique to them (see Tables 4.3 & 4.4) did not affect the results. A criterion of 'equivalence' of the material obtained from subjects' diaries could have been employed. However, this would have reduced the amount of usable material for any one subject. Furthermore, autobiographical memory, which naturally involves individual differences, was being investigated. It was, therefore, perhaps advantageous to use as wide a variation of event types as possible.

One analysis in Experiment 6, Part a - correlating signed dating error and retention interval - did produce rather inconsistent results. The inconsistency was, however, between the overall result and the within-subject results, rather than within the within-subject results. As noted when these results were reported, the overall result is an artifact of between subject retention interval differences, and, in fact, the individual results are reasonably consistent with

retention interval effects which have been observed in other studies. Between-subject retention interval differences could, of course, have been avoided by using subjects with diary material from the same years. However, examining Ornstein's storage size hypothesis required a large overall retention interval, and it would have been difficult to find, say, 10 subjects who had all kept a diary for the same 10 year period.

The between-subject retention interval differences do illustrate a very useful feature of the undirected-diary method. Normally if a researcher wanted to obtain very long retention intervals, a longitudinal research method would have to be employed. With the undirected-diary method it is relatively easy to obtain autobiographical event information which varies in terms of retention interval. Thus the undirected-diary method is particularly suited to investigations of the effect of retention interval on autobiographical memory. However, equating subjects' retention interval may be advisable.

The potential of the undirected-diary method is, however, not limited to its ability to produce very long retention intervals. One of its strongest points is its ability to produce verifiable autobiographical event information which can form the dependent measure in a study of memory. As well as the aspects of memory investigated in Experiment 6, the undirected-diary method might also be useful for the investigation of, for example, emotional aspects of autobiographical memory: Experiment 5 found that a considerable amount of material relating to emotional aspects of autobiographical events is contained in diaries.

Overall, the undirected-diary method appears to be a valuable method for the investigation of autobiographical memory, and, as noted in Chapter 3, overcomes some of the problems associated with conducting ecologically valid memory research. It provides the opportunity for an experimenter to increase the control he or she has over an experimental set-up; for example, it allows one to be reasonably sure that subjects actually experienced the events which they are attempting to recall. Furthermore, diary records, recorded with no prior knowledge of their use in research, are likely to contain information unobtainable by any other means. Finally, the success of Experiment 6, Part b, (the investigation of retrospective duration estimation of autobiographical events), in particular, is in part the direct result of the use of the undirected-diary method.

6.2 Autobiographical Event Memory

Autobiographical memory plays an important part in conversation (Edwards & Middleton, 1987; Larsen & Plunkett, 1987; Linton, 1986; Reiser, Black & Kalamarides, 1986), and in the determination of one's activities and responses (Kolodner, 1983; Ross, 1984). Conversation frequently centres around one's recent experiences, while one's activities and responses are often mediated by past experience. Autobiographical memory, therefore, directly affects our behaviour. Without the ability to recall past experiences, one might have difficulty coping in a social situation where 'striking up' a conversation might be appropriate; and, perhaps most importantly, one may make the same 'mistake' twice. Hence, there are very good reasons for studying autobiographical memory.

6.2.1 Remembering

As an answer to the question 'What did the subjects in Experiment 6, Part a, remember?', one could provide an overall percent value, such as the subjects indicated they remembered 76.4 percent of the spontaneous events. However, because recognized events, that is events the subjects claimed to have recognized after all the event aspect cues had been presented, were counted as remembered, this proportion may be an overestimation of autobiographical event memory. It is possible subjects claimed they recognized an event when in fact they did not.

The inverse relationship between remembering an event and retention interval (shown in Figure 5.2), which is reasonably consistent with the studies of Linton (1982), Wagenaar (1986), and White (1982), however, suggests that the subjects may have been accurate when stating they recognized an event. A similar relationship between autobiographical event memory and retention interval has also been observed in studies which have used Galton's method, that is, where subjects have been required to recall and date specific experiences in response to word prompts (e.g., Crovitz & Schiffman, 1974; McCormack, 1979), and in studies which have examined the temporal distribution of the free-recall (i.e., without prompts) of autobiographical memories (e.g., Rubin, 1982; Rubin & Kozin, 1984).

It was, however, noted in Chapter 5, Section 5.2.2 that the subjects' remembering of spontaneous events appeared to be better than that achieved by Wagenaar (1986), in that overall more events were remembered. This result could indicate that the subjects' claims of event recognition were not accurate. An alternative, and perhaps more likely reason for this result is that the spontaneous events used in this study were more salient than those used by Wagenaar. Wagenaar recorded 2402 events over a five year period which suggests some of his events may have been reasonably 'trivial'. In contrast, the spontaneous events used in this study were significant enough for the subjects to have recorded them in their diaries. On the other hand, inspection of the spontaneous event categorization labels shown in Table 4.3, suggests that the spontaneous events used in this study are typical of the sort of autobiographical events one might routinely recall in conversation.

More detailed information on event memory is given by the results of the event aspect cueing procedure. These results, of course, relate to the recall of specific aspects of an event, but probably also reflect remembering of the event. That is, if a subject, for example, remembered correctly who was involved in an event and its general nature, after having only been told where it occurred, it is probably fair to assume he or she remembered the event.

Consistent with Wagenaar's (1986) study, the different event aspects were found to have different values as retrieval cues, and their efficiency as a prompt to autobiographical event recall can be ordered 'what', 'where' and 'who' from the most to least effective (see Tables 5.1, 5.2 & 5.3). As suggested in Chapter 5, this ranking probably reflects differences in the uniqueness of the three event aspects and may suggest that autobiographical events are stored in memory in terms of their most distinct or unique aspect. In general the 'what' of an event is likely to be its most unique aspect.

If autobiographical events are stored in memory in terms of a uniqueness criterion, 'who' and 'where' would not generally meet this criterion. Storing an event in terms of 'who' or 'where' would be useful if one was involved in the same activity in a new location with different people every day. However, in reality this is rarely the case. Rather the opposite is generally true. That is, one tries to engage in different activities as frequently as possible, but because one usually lives in one place and knows a limited number of people, such activities frequently involve the same people and occur in the

same places. Indeed, examination of the subjects' diary material suggested this was true for the subjects in this study; events often involved the same individuals in the same place, but the nature of the event was different. For example, a subject and his or her close friend may have seen 25 movies at the same cinema, the Who and Where of the events are the same, but the What - the movie - is different in each case.

The subjects' indications of why they could not give a response in the event aspect cueing procedure also suggests the unique aspect of an event is stored in memory. Subjects generally indicated they could not recall other event aspects on the basis of a single cue because the cue applied to too many events, particularly if the cue provided was 'who' or 'where' (see Table 5.4). In other words, it was difficult to recall an autobiographical event on the basis of non-unique event aspect information. These results are also consistent with the overall nature of forgetting. The failure to recall a complete event was frequently attributed to there being too many similar events.

6.2.2 Failure to Remember

Failure to remember autobiographical events has been attributed to insufficient distinguishability of the events to be recalled (Linton, 1975, 1979, 1982; White, 1982), insufficient retrieval cues (Linton, 1982), and the transformation or abstraction of memory content over time (Linton, 1982); the latter two reasons being somewhat related.

As noted, subjects in Experiment 6, Part a, generally reported they could not remember a spontaneous event because it was too similar to other events they had experienced - defined as forgotten-similar (see Table 5.5). Essentially, these events were not 'forgotten'. Rather, the subject determined that the described event could be one of many similar events and that the probability of recalling the specific event in a reasonable time, with the limited cues available, was too small to justify continuing. Marshall and Fryer (1978) suggested that this situation can be seen as a 'trade-off', where search time and effort are weighed against the probability of retrieving the required information.

It is not surprising that similarity to other events was the main reason given for forgetting; individuals do engage in many events which are

essentially the same. Although any event has the potential to become a frequently occurring event, some events are more likely to fall into this category than others. Indeed, analysis in Chapter 5, Section 5.2.3 found that some types of events were particularly likely to be forgotten-similar (e.g., baby-sitting) when compared to other events such as accidents (see Table 5.6). Furthermore, the more trivial the event, perhaps the more likely it is to be one of many similar events, which may account for Wagenaar's (1986) memory performance.

In addition to events not recalled because of similarity to other events, a number of events were not recognized at all by the subjects (defined as forgotten-foreign), suggesting that the required event information may have been lost from memory. Alternatively, the retrieval cues provided may have been insufficient. That is, an event a subject did not recognize at all may have been remembered if sufficient information had been supplied. Furthermore, no indication of why the forgotten-foreign events were forgotten was found when this type of event forgetting was examined across different types of events: type of event was not related to this reason for event forgetting (see Table 5.6).

Relating to the value of retrieval cues, Linton (1982) noted that: "With the passage of every year the cues become more 'contrived' and removed from both my contemporeous memory organization and from cues that I would spontaneously employ to elicit these memories" (p. 79). The possibility of transformation of memory content over time suggests that the cues provided in Experiment 6, Part a, may have been insufficient for recall because they described the event at the time of its occurrence (its diary description) rather than its present memory representation. Evidence of the transformation of an event's memory with time is seen in the unsolicited responses made by some subjects when dating 'exactly dated' events (see Table 5.19). For an 'Attending movie/theatre' event and a 'Field trip' event the subjects indicated at the time the events were dated that they were the 'first' date/meeting with a long time friend (boyfriend/girlfriend). Hence, the subject's memory of these events probably had changed with the passage of time.

An event may also have been encoded in memory <u>at the time of its occurrence</u> in a different way to that described by the event aspect cues (its diary description). Evidence in support of this also comes from the events in

Experiment 6, Part a, that were exactly dated. The unsolicited subject responses indicated the hidden nature of some of these events, for example, the horse riding event was dated exactly because it occurred on a friend's birthday, it may therefore have been encoded in memory as part of a friend's birthday celebration rather than a ride on a horse. It is, therefore, possible that subjects would have remembered some forgotten-foreign events if they had been described in a different way.

The above discussion of why events were forgotten might also explain why no significant difference in retention interval between the forgotten-similar and forgotten-foreign events was found. As time passes, more occurrences of similar events are likely to occur. Therefore, the distinguishability of one particular occurrence, be it a recent or remote occurrence, will diminish over time. Hence, forgotten-similar events can be both recent and remote events.

Forgotten-foreign events, on the other hand, could also have occurred recently or long ago. Both recent and remote forgotten-foreign events could be the result of insufficient retrieval cues, specifically, the possibility the event might have been described in a different way by the presented cues to the way it was originally encoding in memory. Furthermore, remote forgotten-foreign events, in particular, may also reflect the abstraction or transformation of memory content over time; the other reason why retrieval cues may have been insufficient.

6.2.3 Organization of Autobiographical Memory

The results outlined above, and their interpretation, provide a basis from which to discuss the organization of autobiographical memory in terms of the processes of encoding, storage and retrieval. In this section, these three aspects of memory are discussed both separately, and in terms of how they relate to each other.

Fitzgerald (1986), in defining autobiographical memory, suggested that such memories are "stored without the benefit of conscious memory goal activities on the part of the individual" (p. 122). This may be generally true: one does not usually think, for example, 'I must remember this game of tennis'. However, autobiographical experiences (events) form the basis of

semantic memory, or, as defined in Chapter 1, 'the generalized knowledge a person has about the world'. Semantic memory is the product of autobiographical experiences. Hence, specific aspects of an autobiographical experience may be actively encoded in a learning type manner. For example, one probably learns how to make toast by actually making it. When learning the task, the individual notes the steps involved (tries to remember them). However, at the same time, the individual probability does not consciously think of remembering his or her first experience of making toast.

It is, therefore, perhaps best to consider the encoding of autobiographical experiences, a process which can involve the active encoding of specific aspects of general knowledge (e.g., how to make toast). However, generally the experience of an event is all that is registered in memory, and this encoding is probably not the consequence of a conscious activity.

Autobiographical event information stored in memory may take the form of unique event information, one remembers having experienced an event. Furthermore, a specific aspect of knowledge obtained from an experience may also be stored in memory. The storage of unique event information and specific aspects of knowledge are both probably effected by repeated experience, although in a different way. Learning or the storage of specific knowledge is enhanced with repeated experience, and, at the same time, the unique event memory is transformed into a generalized representation or schema (Schank & Abelson, 1977) which contains the distinguishing feature of the particular type of event or experience. As illustrated in Experiment 6, Part a, the occurrence of many similar events is paralleled by an inability to recall a specific occurrence. Yet the subjects knew the event described had actually occurred (recognized the event), which suggests such events are stored in memory as a generalized representation.

Such reasoning suggests that retrieval from autobiographical memory can be either reconstructive or represent the direct access of a unique experience, or specific piece of knowledge. Evidence of the direct access of unique experiences was found in Experiment 6, Part a, in that the subjects were able to recall some events correctly on the basis of a single cue. Some of these events were undoubtedly 'once in a life time' experiences which are unlikely to be represented in memory in a schematic form. Furthermore, the subjects'

indication of how they generated the responses was overwhelmingly, "I remembered", rather than I guessed or inferred.

The notion that recall is often reconstructive is not new in the field of memory research, and it is frequently cited as Bartlett's (1932) principal legacy to modern psychology (Edwards & Middleton, 1987). More recently Barclay (1986) has provided empirical evidence for the reconstructive nature of autobiographical memory. Evidence was also found in Experiment 6, Part a, that memory is often reconstructive. The day of the week on which an event had occurred was frequently reconstructed rather than remembered, similarly the dating of events was found to generally involve reconstructive processes (see Section 6.3.4). Furthermore, a reconstructive model is used to explain the estimates of autobiographical event duration obtained in Experiment 6, Part b (see Section 6.4.2).

The subjects in Experiment 6, Part a, were reasonably good at determining what day of the week an event had occurred on, even if they could not actually remember the event (see Tables 5.7 & 5.8). However, the processes involved in determining this information were mediated by the actual day of the week that the event occurred on (see Table 5.9). Day of the week reconstruction, in particular, was associated with events that actually occurred on a Friday, Saturday or Sunday. As already suggested in Chapter 5, this is probably due to particular activities occurring almost exclusively on these days of the week. These results are in disagreement with those obtained by Friedman and Wilkins (1985), who found no evidence for day of the week reconstruction, although they did find that recall of day of the week information did not exhibit a systematic increase in error with increasing retention interval. Thompson (1982) also examined subjects' ability to recall day of the week information, noting that it was no better than the recall of date information.

Day of the week information may be part of an event's schema if it is consistent enough to be a frequently occurring aspect of an event. For example, if a particular event almost always occurs on a Friday, part of the generalized representation of this event might be that it is a 'Friday' event. Friedman and Wilkins (1985) also noted that various events might be associated with a specific day of the week.

Furthermore, Friedman and Wilkins (1985) suggested that "several days might share many of the same associations" (p. 175), which might explain why the day of the week of events that actually occurred on Mondays, Tuesdays, Wednesdays and Thursdays were not frequently reconstructed in Experiment 6, Part a. Studies of temporal orientation (e.g., Koriat & Fischhoff, 1974; Koriat, Fischhoff & Razel, 1976; Shanon, 1979) support this interpretation. Week days (Monday through Thursday) appear to be relatively indistinguishable: the time a subject will take to tell you what day of the week it is for these week days are similar, whereas the response times for Friday, Saturday and Sunday are also similar, but generally shorter than for week days. Such results might also account for Thompson's (1982) findings, as the events that his subjects attempted to recall the day of the week for all occurred on week days (e.g., Monday through Friday).

Overall, the organization of autobiographical memory seems to follow some reasonably straight forward steps. Memory routinely records that one has experienced an event. If some aspect of the event might be a useful piece of knowledge one may consciously register this information in memory. If one experiences an event similar to one previously experienced, the original event memory is updated if some aspect of the second experience suggests it should be. Hence, memory of a frequently occurring event becomes more abstract as more occurrences of this type of event are experienced, and at the same time it becomes more difficult to recall an actual occurrence. One's memory of an autobiographical event is likely to be directly accessed if (a) sufficient cues are provided for recall, and (b) the event is unique, not one of many similar events that have been experienced. If one tries to recall information about an event which is one of many similar events experienced the task is likely to be particularly difficult, although the abstract memory representation of the event will probably be sufficient for one to reconstruct some event information.

6.3 Dating Autobiographical Events

Three different situations in which an individual might make a duration estimate were used in this thesis. However, it was noted in Chapter 1 that, although the dating of an event can be interpreted as a duration estimate (the date assigned to an event defines the time elapsed since its occurrence), the memory processes involved may be somewhat different to those used where the response is an actual duration estimate (e.g., 43 days). In order to examine

this possibility, and to allow the results obtained in Experiment 6, Part a, to be compared to other research on event dating, the subjects were asked to recall the date when their events had occurred, rather than how long ago they had occurred.

6.3.1 The Relationship Between Actual and Assigned Date

The relationship between actual and assigned date found in Experiment 6, Part a, is similar to that reported in a number of other studies (e.g., Baddeley, Lewis & Nimmo-Smith, 1978; Brown, Rips & Shevell, 1985; Brown, Shevell & Rips, 1986; Ferguson & Martin, 1983; Lieury, Caplain, Jacquet & Jolivet, 1979; Livson & McNiell, 1962; Underwood, 1977; White, 1982), the two variables being positively correlated. The size of both the overall correlation and the within-subject correlations were also reasonably consistent with those reported in the above studies (see Table 5.10).

Also of relevance to the present discussion is the remarkably high correlation obtained between actual and assigned date for the forgotten events. The subjects do appear to have been able to determine when an event they could not actually remember had occurred. A possible explanation for this was suggested in Chapter 5: the description of the event may have tied it to a particular point in time. For example, an individual named in a 'who' cue may have been someone the subject had had contact with only once, and, although the specific event being described could not be recalled, the approximate date of the event's occurrence could be reconstructed from this information.

The subjects' ability to date forgotten events with some accuracy provides support for a reconstructive model of event dating. If date information was stored in memory as part of the memory trace for the event as a whole, and the event memory could not be accessed (remembered), the date information would also be unavailable. It is quite probable that the subjects' ability to produce a date for a forgotten event reflects the general nature of event dating; event dating does not generally involve direct access to date information, but rather the reconstruction of a date using the available information.

6.3.2 Dating Error: Absolute

Overall, the subjects were about two months out in their determination of when their events had occurred (see Table 5.10). Although this is less than that found by Brown et al. (1985) and Underwood (1977), and more than that reported by Rubin (1982), and Loftus and Marburger (1983), methodological differences across the studies probably account for most of the between study variation. For example, as noted in Chapter 1, Loftus and Marburger (1983) counted dating errors greater than 7 days as 7 days (also see Section 6.3.5 in which a possible reason for between study absolute dating error differences is outlined).

The obtained positive relationship between retention interval and absolute dating error (see Table 5.10) is consistent with that found in previous studies (e.g., Baddeley et al., 1978; Barclay & Wellman, 1986; Friedman & Wilkins, 1985; Lieury et al., 1979; Linton, 1975; Thompson, 1982, 1985a, 1985b; Thompson, Showronski & Lee, 1988), as is the observed tendency for absolute dating error to decrease as event knowledge increased (e.g., Friedman & Wilkins, 1985; Kemp, 1988; Thompson,1982; 1985a; 1985b; White, 1982). The latter trend was, however, not significant in Experiment 6, Part a, when examined across events that varied in the degree to which they were remembered, but was significant when the comparison was between remembered and forgotten events; the latter events being dated significantly less accurately (see Table 5.12). This result suggests that the extent to which an event is remembered has only a limited effect on dating accuracy.

The finding in Experiment 6, Part a, that the degree of event knowledge for remembered events did not significantly affect dating accuracy (absolute error), may indicate that the knowledge ratings used in other studies which have found a significant relationship between event knowledge and dating accuracy (e.g., Kemp, 1988; Thompson, 1982; 1985a; 1985b; White ,1982) are not a particularly sensitive measure of event knowledge. Event knowledge in Experiment 6, Part a, was objectively assessed through the use of the event aspect cueing procedure, which may be more sensitive to between event knowledge differences than scale ratings. Alternatively, the autobiographical events used in this study may have generally been better remembered than the events used in the above studies. Hence, between event knowledge differences

in this study may not have been sufficient to produce an overall significant effect of event knowledge on dating accuracy.

Dating accuracy (absolute error) also varied significantly between the forgotten-similar and forgotten-foreign events, the latter events being dated more accurately (see Figure 5.4). This result is consistent with the explanation proposed above to account for the subjects' ability to date events they could not actually remember: the forgotten-similar events were probably more difficult to tie to a specific point in time. By definition, this type of event forgetting resulted because the event was possibly one of many similar events which might well have occurred over a number of years, thus making the task of determining the date of a specific occurrence particularly difficult.

Similarity between the remembered and forgotten events was found when dating error was examined in terms of the time scales used, that is, in terms of the subjects' ability to assign an event to the correct year, correct year and month, and correct year, month and day of the month (see Table 5.11). For both the remembered and forgotten events, the subjects' ability to correctly date an event diminished as the time scale used became more precise. Placing an event in the correct year was achieved quite frequently, while getting the actual day of the month right was a relatively rare occurrence. Again date response characteristics appear to be largely independent of event memory, which argues for date reconstruction. This result also suggests that the subjects' ability to reconstruct a date may be limited. Reconstruction may provide a means of generating an approximate date, perhaps year and month, but is not very efficient as a means of providing the more precise component of day of the month.

6.3.3 Dating Error: Signed

Overall, the events dated in Experiment 6, Part a, were dated more recently than they had actually occurred (see Table 5.13). That is, there was a slight tendency for event age to be underestimated, a result frequently found in dating studies (Kemp, 1988). The regression analysis, however, indicated that the actual age of the event affected the sign of the dating error, with the age of recent events tending to be overestimated and the age of remoter events being underestimated, a finding which is also typically found in studies which have examined event dating (e.g., Baddeley et al., 1978; Brown et al., 1985; Ferguson

& Martin, 1983; Gibril, 1976; Kemp, 1988; Lieury, Aiello, Lepreux & Mellet, 1980; Lieury et al., 1979; Loftus & Marburger, 1983). Further evidence of a relationship between signed error and retention interval was found when these two variables were correlated for each subject; all of the obtained correlations were positive (see Table 5.13).

Signed error was also examined in relation to event knowledge, but no significant trends were observed (see Table 5.14). Thus in contrast to Brown et al. (1985), but consistent with the findings of Kemp (1988) and Thompson et al. (1988), the age of the better remembered events was not significantly underestimated. There was also no significant difference in the sign of dating error between the remembered and forgotten events, which suggests that the tendency for the older events to be dated too recently was not due to the age of forgotten events being underestimated (as already noted, more events were forgotten as retention interval increased).

The effect of boundaries on event dating was also examined. As noted in Chapter 1, Section 1.3.3, Huttenlocker, Hedges and Prohaska (1988) and Rubin and Baddeley (1989) have suggested that systematic dating errors may be the result of boundary effects: i.e., assigned dates will move towards the centre of the boundaries defined by a subject's submitted diaries because the subjects will not assign dates outside the boundary markers. Figure 5.5 generally supported this suggestion showing that most of the subjects gave date responses which were inside the boundaries defined by their submitted dairies. Therefore, signed dating errors for the remote and recent events probably were generally positive and negative respectively.

Furthermore, Experiment 6, Part a, established that absolute dating error was positively related to retention interval. Thus there was more dating error associated with the older events and the boundary effects would suggest the signed error for these events would be positive. Hence, more dating errors would be positive, which is in fact what the overall positive signed error obtained in Experiment 6, Part a, indicated.

In conclusion, the date assigned to an event is not very likely to be exactly correct. Dating accuracy appears to vary systematically with retention interval. In this respect the recall of date information is similar to the recall of other event information in that recall performance decreases as retention

interval increases. There is some evidence that how well one remembers an event will affect the accuracy of a date assigned to it. However, an approximate date can usually be assigned even if one can not remembered the event being dated (it is forgotten). Although the reason why one can not remember an event will generally determine how accurate this approximate date will be. Finally, the nature of dating errors (under- or over-estimation of event age) also varies with retention interval. No evidence that this effect is the result of between event knowledge differences was found. Some evidence of boundary effects were, however, found, and which appear to adequately account for the signed error results obtained in this experiment.

6.3.4 A Model of Autobiographical Event Dating

Overall, the subjects' indications of how they dated their events both support a reconstructive model of event dating and are consistent with other studies which have examined how events are dated (e.g., Baddeley et al., 1978; Brown et al., 1986; Friedman & Wilkins, 1985; Linton, 1975; Loftus & Marburger, 1983; Robinson, 1986; Thompson, 1982; Thompson et al., 1988; Wagenaar, 1986; White, 1982). Furthermore, some of the results discussed above, as noted, suggest that the date assigned to an event is reconstructed rather than directly accessed.

Reconstructive dating in Experiment 6, Part a, was generally based on the use of before and after event landmark events, and information given in the event aspect cues presented (see Table 5.15). The unsolicited responses (statements) that some subjects made when dating events provide some information on the nature of landmark events (see Table 5.19). The actual date of birthdays and public holidays appear to be particularly likely to be remembered and were apparently used by the subjects to date events: used as landmark events. Furthermore, more of the unsolicited responses referred to autobiographical events (birthdays) than public events which is consistent with other research which has found that subjects generally prefer to use personal landmark events when dating events (e.g., Brown et al., 1986; Friedman & Wilkins, 1985; Lieury et al., 1980).

Examination of the dating strategies adopted for each date component (see Table 5.15), however, suggests that the year and month component were quite frequently reconstructed, whereas the day of the month component was

more often guessed than reconstructed. Describing event dating as generally reconstructive may, therefore, be an overgeneralization: generally only part of an event's date is reconstructed. This, of course, suggests that reconstructed dates may be in error because the reconstructive process is limited in its ability to generate a complete date: some guessing is still required. Furthermore, dating strategy adoption also varied with retention interval and event knowledge; these results are, however, interpretable within a reconstructive model of event dating.

Examination of the relationship between dating strategy adopted and retention interval (see Table 5.17) indicated that more date information was said to be remembered at shorter retention intervals and that guessing increased as retention interval increased for all three date components. The proportion of reconstructive dating, on the other hand, was relatively constant as retention interval increased for the month and day of the month components. Together these results suggest, in relation to month and day of the month date components, that when a relatively recent event's date can not be recalled an attempt is made to reconstruct it, but when the event is relatively old, a guess is made rather than an attempt at reconstruction. These results are consistent with date reconstruction using landmark events: fewer events are recalled as retention interval increases, thus fewer landmark events may be available for the reconstructive dating of relatively old events.

Robinson (1986) suggested that landmark events "may be said to constitute a person's *'temporal frame of reference*'" (p. 162), and that any particular month may vary in its importance for this temporal reference system because of the density of marker events it contains. The above results suggest that years may also vary in their importance in a temporal reference system; not, however, because a particular year is likely to have more or less marker events, but because fewer of these events are likely to be recalled as time passes. Thus landmark event availability might be inversely related to retention interval.

The observed relationship between event knowledge and date reconstruction (see Table 5.18) for the month and day of the month date components is also consistent with the above interpretation. When event memory was relatively strong, but the subject could not remember the date of

the event, the subject preferred to try and reconstruct the date, whereas the dates of the poorly remembered events were guessed.

The year component appears to have shown a quite different relationship between retention interval and date reconstruction, and between event knowledge and date reconstruction. Reconstruction of the year component increased as retention interval increased and event knowledge decreased. Such results, however, are not necessarily inconsistent with the preceding reasoning. Perhaps fewer landmark events are needed to reconstruct the year than the month or day of the month: subjects were able to produce more correct year of occurrence information than month or day of the month information (see Table 5.11).

The reconstruction of an event's date is a rather complex process, and may only be used to generate part of an event's date, generally year and month information. Furthermore, the age of the event and how well it is remembered appear to determine if these date components, particularly the month component, will be reconstructed. Event dating is ,therefore, not generally reconstructive. Rather, when the conditions are right a conscious attempt will be made to reconstruct the date using landmark events and information recalled about the event; otherwise a date response will generally be a guess.

6.3.5 Inconsistencies in Event Dating Studies

A number of dating studies have produced inconsistent results. For example, Brown et al. (1985) found a mean absolute dating error of 11 months, and Underwood (1977) a similar value of 15 months, while Rubin (1982) found an overall median absolute error of only 3 days. Although the former studies reported a mean value and the latter a median value it seems unlikely the choice of statistic would account for the marked difference. Furthermore, between study retention interval differences seem unlikely to account for the absolute error difference: the events in Brown et al's study occurred up to five years before the experiment, while Rubin's subjects used their diaries to check assigned dates and these diaries covered on average 6 years. It is more likely that the difference is related to the type of events dated. Brown et al. (1985) and Underwood (1977) both had subjects date public events, whereas Rubin's subjects dated autobiographical events.

One difference between dating studies which use autobiographical events and those which use public events is that in the latter type of study it is generally assumed that the subjects learnt of the events at the time of their occurrence. Two factors primarily affect the validity of this assumption; (a) the diffusion of public event information and, (b) the possibility of acquisition of event information long after an event's occurrence.

Information on events 'covered' by the media has the potential to become public knowledge, but at the individual level one's exposure to media sources (e.g., newspaper reading, watching television) largely determines if an individual will have heard of a specific event. The extent of media coverage is also important, although generally public events used in dating research have received extensive media coverage. This situation has prompted some authors to suggest that research using public events can not be validly conducted using subjects that are not interested in 'news' (e.g., Erickson and Scott, 1977; Sander, 1972). Support for this position was found in a study by Johnson and Klingler (1976) in which rated interest in 'news' was found to be positively correlated with public event knowledge.

Furthermore, interest in the 'news' is a complex dimension mediated by at least age and education and possibly also sex differences. Education is reported to be positively correlated to self-exposure to public event information (e.g., Gaziano, 1983; Robinson, 1967; Schramm and White, 1949; Tichenor, Donohue and O'lien, 1980; Wade and Schramm, 1969), and to public event knowledge (e.g., Botwinick and Storandt, 1974; Deutschmann and Danielson, 1960; Johnson & Klingler, 1976). Similarly, media use increases significantly with age (e.g., McCombs & Poindexter, 1983; Schramm & White, 1949). However, not only does the amount of self exposure to the media increase with age but also the type of information sought changes. Primarily, individuals first seek entertainment from the media, and around the age of 12 they begin to use the media to obtain information on public events (Peterson, Jensen and Rivers, 1965; Schramm & White, 1949). This increase in media use and change in emphasis with age has been found to be positively related to public event knowledge (e.g., Atkin and Gantz, 1978; Chaffee, Ward and Tipton, 1970; Conway, Stevens and Smith, 1975; Johnson & Klingler, 1976).

The evidence relating to a sex difference in media use is unclear: Weber and Fleming (1983) found that males used the media as a source of public event

information more than females. However, a similar study by McCombs and Poindexter (1983) did not find a sex difference. A sex difference such as that observed by Weber & Fleming might, however, account for the finding that males consistently score higher on tests of public event knowledge (e.g., Botwinick and Storandt, 1974; Deutschmann and Danielson, 1960; Robinson, 1967; Weber and Fleming, 1983).

There are, therefore, a number of factors which can affect whether an individual learnt of a specific public event at the time of its occurrence. Careful selection of the public events used in research can increase the likelihood that events are used that were learnt of when they occurred. Some events, for example the assassination of J. F. Kennedy, have such an impact and have drawn the concentrated and simultaneous focus of all the media, that over 90 percent of public samples report knowing of the event's occurrence within one day (Deutschmann and Danielson, 1960; Gaziano, 1983). However, a percentage of the population, often referred to as 'chronic knownothings' (Gaziano, 1983) or 'the unenlightened' (Robinson, 1967), will never hear of such events.

Using well-known public events in research can, unfortunately, increase the likelihood that the subject learnt of the event long after its occurrence, as information about 'significant' public events is available in, for example, historical texts and almanacs. However, studies that have investigated the extent of post-event information acquisition (e.g., Squire, 1974; Squire, Chase and Slater, 1975) have generally found that it is minimal. Furthermore, research on media behaviour has reported that daily sources (e.g., newspapers and television and radio news broadcasts) are generally where people obtain information on public events (e.g., Adams, 1981; Weber and Fleming, 1983).

Overall, there is some basis for questioning the validity of the assumption that individuals learn of public events at the time of their occurrence. Thus, there is a possible discrepancy between the date an event occurred on and the date the subject learnt of its occurrence. In terms of reconstructing the date of a public event this situation could produce an increase in dating error.

6.4 Retrospective Duration Estimation

In Experiments 2 and 4, retrospective duration estimates of public events were obtained, while in Experiment 6, Part b, similar responses were obtained for autobiographical events. Overall, the experimental design was dictated by the experimental hypothesis being tested; Ornstein's (1969) 'storage size' hypothesis. However, failure to find support for this hypothesis in Experiment 2 prompted the formulation of a reconstructive model of duration estimation, and largely determined the experimental design of Experiments 3 and 4. Experiment 6, Part b, also failed to find any support for Ornstein's hypothesis, and as noted in Chapter 5, produced results which are consistent with the subjects reconstructing event duration.

6.4.1 Ornstein's Model of Duration Estimation

The fact that event knowledge was found to be variable over the different public and autobiographical events used, enabled a test of Ornstein's model. In Experiments 1 and 2, the significant negative correlation between retention interval and event knowledge was consistent with Ornstein's (1969) prediction that "when some period elapses before an interval is to be judged...some items should drop out of storage" (p. 48). Retention interval was, however, not significantly correlated with event knowledge in Experiment 6, Part b, although the knowledge ratings did vary between events, allowing Ornstein's model to be tested.

The lack of a systematic decrease in rated knowledge as retention interval increased observed in Experiment 6, Part b, might cast doubt on the validity of the ratings, but there is an alternative explanation. It may be that the retention interval range used in Experiment 6, Part b, was not sufficient for the older duration events to have faded from memory. In relation to event dating, events which occurred within a duration event, such as the filled duration events used in Experiment 6, Part b, have been found to be dated quite accurately (e.g., White 1982). Furthermore, the reasonably small number of duration events that were found in the subjects' diaries suggest they are reasonably rare and thus are perhaps rather unique. It is therefore possible, particularly considering the amount of information which might be encoded during a duration event, that one's memory of such events might be reasonably good for a considerable period of time.

Overall, very little support was found for Ornstein's suggestion that the size of a duration estimate is directly proportional to the amount of information stored in memory from the interval which is being estimated. The results of Experiment 2, which did appear to support the storage size hypothesis, were more adequately interpreted through the formulation of the reconstructive model of duration estimation. This model suggests that the positive relationship found between event knowledge and estimated event duration reflects an increase in estimation accuracy as event knowledge increases.

In Experiment 6, Part b, despite extensive analyses, little support was found for Ornstein's model. Overall, the subjects were very accurate at estimating the duration of events they had experienced (see Table 5.20). On the basis of this observation alone, one would be tempted to conclude that the subjects either actually remembered the duration of their events or reconstructed them. The duration of some of the events was perhaps actually remembered, although the majority were probably reconstructed. The reconstructive model of duration estimation is, of course, based on the assumption that duration information is encoded in memory at the time of an event's occurrence, thus there is the possibility of actually remembering an event's duration.

6.4.2 The Reconstructive Model of Duration Estimation

The reconstructive model of duration estimation outlined in Chapter 2 is similar to other reconstructive accounts of memory. Information about unique experiences is encoded in memory, and repeated exposure to similar events creates or results in the formulation of a generalized representation or schema relating to that type of event. This form of abstraction provides a way of recalling information about particular types of events when the type of event is a frequently occurring one and one for which it is difficulty to keep track of specific occurrences. Evidence of this type of abstraction and retrieval failure was seen in the results of Experiment 6, Part a, relating to the forgotten-similar events.

It has already been noted that the dating of events sometimes involves the use of general temporal knowledge. Thus one's representation of some events contains or has associated with it time information, in this case when

the particular event is likely to occur (e.g., in the summer). Furthermore, evidence was found in Experiment 6, Part a, that time information relating to the day of the week a particular type of event usually occurs on is also stored in the representation of some events. Overall, such findings support the suggestion that duration information may be stored in the memory system in a similar way. Indeed, why should the temporal aspect of duration be treated in a different way to, for example, the temporal aspect of day of the week by the memory system?

Duration information is probably also a significant feature of some events, and as such would need to be included as an aspect of the memory representation of such events. Duration certainly is an essential aspect when defining some events. For example, one would need to emphasise the feature of duration when explaining to someone what a holiday was. A holiday without duration would not be a holiday.

Duration information may, however, be slightly different to other aspects of information stored in an event's schema representation. Consider, for example, day of the week information. An event, such as going for drinks with your work colleagues, may almost always occur on a Friday, but sometimes occur on a Thursday. It is possible that the abstraction of day of the week information will ignore the occasional Thursday occurrence. Thus a Friday response would be given when asked what day of the week a particular drinks occasion took place on. Duration is also likely to vary over a definable range, or within specific boundaries for any specific type of event. For example, a holiday might last 2 or 22 days (Indeed, the events used in Experiment 6, Part b, are testimony to this; events given the same categorization label frequently varied slightly in terms of actual duration). However, in contrast to day of the week information, the memory system, when abstracting duration information may store duration range information rather than the most frequently occurring duration. That is, one remembers that a particular type of event lasts between X and Y days. This duration range information may be updated if an event occurs with a duration which is outside the stored range.

Duration estimation, however, normally requires a single value rather than a range. A reconstructed duration estimate, therefore, represents a point somewhere within the stored range, perhaps near the most frequently occurring point or some other central value unless some information is

available which results in another point on the range being selected. This is where specific event knowledge, or actually remembering the event for which a duration estimate is being made, helps to increase estimation accuracy. The extent to which actual event knowledge will increase estimation accuracy will, however, probably depend on: (a) how typical, in terms of duration, the event being estimated is, and (b) the type of event's duration range.

In the situation where the particular event for which duration information is required has an usually long or short duration (in terms of duration, is very atypical), specific event knowledge may significantly increase estimation accuracy. However, if the duration is only slightly atypical, the effect on estimation accuracy of specific event knowledge would be less marked. Consider, for example, a type of event with a duration range of 6 to 10 days. An individual who can not recall the specific event may reconstruct a duration estimate somewhere between 6 and 10 days, perhaps 8 days. Now if the event being estimated had an atypical duration of, say, 12 days, the reconstructed duration estimate would be in error by 4 days. However, if the event's actual duration was 50 days (very atypical) the reconstructed duration estimate would be in error by 42 days. Thus the extent to which a specific event's duration is atypical determines the extent to which specific event knowledge can increase estimation accuracy, or inversely, decreases the estimation error associated with a reconstructed duration estimate.

Evidence of the effect of how typical the duration of the event being estimated is and event knowledge was found in Experiments 2 and 4. The Pope John Paul I event (estimation of the reign of Pope John Paul I who died suddenly of a heart attack) might be considered to have an atypical duration, his reign of 33 days is reasonably short. Inspection of Table 2.3 indicates that the median duration estimate of the subjects who did not remember the event (330 days) is reasonably large, while the median duration estimate of the subjects that did remember the event (73.5 days) is somewhat closer to the event's actual duration. Table 2.5 shows a similar pattern for this event.

As noted, the duration range of an event can also effect the accuracy of a reconstructed duration estimate. If the duration range is relatively large, say a particular type of event could last from 20 to 80 days, a reconstructed duration estimate for this type of event may be somewhere around 60 days. If its actual duration was 79 days, estimation error would be 19 days. On the other hand, if

the event's duration range was relatively small, say the event could last from 70 to 80 days, a reconstructed duration estimate might be 75 days, and the estimation error would only be 4 days. Thus the duration range of a type of event also affects the accuracy of a reconstructed duration estimate, and the extent to which actual event knowledge can increase estimation accuracy.

This discussion of the reconstructive model of duration estimation has gone beyond a simple interpretation of the experimental results, but in doing so has illustrated the complex nature of the model. Experiments designed to test factors such as the storage of event duration range information in memory, the proposed links between how typical a specific event is in terms of duration and the accuracy of a reconstructed estimate, and the relationship between the size of the duration range of a type of event and a reconstructed duration estimate's accuracy, would help refine the model. However, even in its present form it appears the most adequate account of retrospective duration estimation currently available.

6.4.3 The Effect of Ecological Validity on Duration Estimation Characteristics

Two factors primarily distinguish the duration estimation experiments used in this study (Experiments 1 through 4 and Experiment 6, Part b) from those which have typically been used to investigate duration estimation. First, the events were typical of those experienced in everyday life, and for which duration information might be routinely recalled. That is, in contrast to traditional duration estimation research, the intervals which subjects estimated the duration of were not manufactured by the experimenter. Rather they were specific events in the past that were identified as having a definite duration. Second, actual event duration was relatively long.

Hence, Experiments 1 through 4 and Experiment 6, Part b, in contrast to previous investigations of the estimation of duration, have a degree of ecological validity. The most obvious effect of this was that it allowed the subjects the opportunity to reconstruct event duration. They were able to use past experience in a way not permit by Ebbinghaus type experiments. It is therefore, not surprising that little support for Ornstein's model was found; his model was based on the results of Ebbinghaus type experiments.

A number of studies which have reported duration estimates of everyday life events were discussed in Chapter 1, Section 1.1.5. The general tendency observed in these studies was for event duration to be overestimated (e.g., Douglas & Blomfield, 1956; Mednick & Shaffer, 1963; Schneider, Griffith, Sumi & Burcart, 1978). Little evidence of a general tendency towards event duration overestimation was, however, found in Experiment 6, Part b. Although the overall median estimated duration was 1.0 day larger than the overall median actual duration, the overall median signed error of 0.0 days indicates the estimates were not generally over- or under-estimations of actual event duration (see Table 5.20). The overall median signed error for the empty duration events was, however, 1.0 day indicating a slight tendency towards event duration overestimation for these events (see Table 5.21), although, as noted in Chapter 5, Section 5.3.1, the duration estimates of the filled and empty duration events were not significantly different.

Two conclusion can be draw from the above results. First, type of event, filled or empty duration, did not have a marked effect on duration estimation, a result which is inconsistent with traditional duration estimation research i.e., the filled duration illusion. Indeed, the overall median actual and median estimated duration were identical for both the filled and empty duration events (see Table 5.21). Second, duration estimates of autobiographical events are equally likely to overestimations as underestimations. In fact the results suggest they are quite likely to be very accurate.

There is, however, some similarity between the duration estimation results obtained in Experiment 2 and Experiment 6, Part b, and those typically obtained in traditional duration estimation studies. As noted in Chapter 1, Section 1.1.1, the actual duration of the stimulus interval has been found to affect duration estimation, with duration over- and under-estimation typically being associated with short and long stimulus intervals, respectively (Eisler, 1976; Kane & Lown, 1986; Kowal, 1987). Stimulus interval duration has, however, generally been manipulated within a rather small range, that is, long stimulus intervals have generally not exceeded one minute. In contrast, actual duration in this study ranged from 2 to 448 days in Experiments 2 through 4, and from 3 to 550 days in Experiment 6, Part b. However, despite this marked actual duration difference, the regression analysis of both Experiment 2 and Experiment 6 , Part b, indicated a tendency for short duration events to be overestimated and long duration events to be underestimated. Furthermore,

the exponent of .86 obtained in Experiment 6, Part b, is particularly close to the .9 value which Eisler (1976) obtained in his review of 111 duration estimation studies. It might, therefore, be concluded that the duration estimation of relatively long events is subject to similar actual duration effects to those observed in the duration estimation of relatively short intervals. This overall result also suggests that duration estimates under laboratory conditions, and somewhat more ecologically valid conditions, are in some respects similar.

The exponent of .86 obtained in Experiment 6, Part b, is, however, somewhat different to the exponent of .50 obtained in Experiment 2. Although the latter exponent does indicate a systematic change in duration estimation with actual duration, the tendency is not as evident as in Experiment 6, Part b. The regression analysis correlations of .69 for Experiment 2 and .81 for Experiment 6, Part b, as well as the correlations between estimated and actual duration $r = .66$, $P < .05$ and $r = .85$, $P < .001$ for Experiment 2 and Experiment 6, Part b, respectively, also vary somewhat between the experiments.

Experiment 2 and Experiment 6, Part b, are different in that the former obtained duration estimates of public events, and the latter duration estimates of autobiographical events. Section 6.3.5 discussed the possible effect such a difference might have on event dating, suggesting that the uncertainty surrounding the acquisition of public event knowledge may be responsible for dating accuracy differences between public and autobiographical events, particularly if, as it appears, such dates are reconstructed. This discussion suggests autobiographical duration events may be better remembered than public duration events because obtaining information about the latter is largely mediated by one's exposure to the media, and may explain the between experiment differences noted above.

The overall mean knowledge rating obtained for the public events (Experiment 2) of 2.6, and the autobiographical events (Experiment 6, Part b) of 3.7 support the above suggestion: the autobiographical events were on average better remembered. Furthermore, comparison of the accuracy of the public and autobiographical event duration estimates indicates that generally the latter were more accurate (see Table 2.2 and Table 5.20). The correlations between actual and estimated event duration obtained in Experiment 2 and Experiment 6, Part b, are further evidence of this. These results are also consistent with the positive effect of event knowledge on estimation accuracy proposed in the

reconstructive model of duration estimation, and may account for the public event/autobiographical event exponent difference.

The large exponent obtained for the estimation of autobiographical event duration in Experiment 6, Part b, probably reflects the fact that the estimates were closer to actual event duration because the events were reasonably well remembered. The small exponent obtained in Experiment 2, on the other hand, may reflect the fact that estimated duration was not closely related to actual event duration because the events were not particularly well remembered.

The overall mean knowledge rating difference between the public duration events and the autobiographical duration events is consistent with the suggestion made in Chapter 1; that a depth of processing distinction might be made between these two types of event. Furthermore, examination of Table 2.2 and Table 5.20 indicates that overall, the duration of public events was underestimated and the duration of autobiographical events was overestimated. This result could be interpreted as support for Ornstein's model of duration estimation, the better remembered events (the autobiographical events) were given larger duration estimates. However, considering the experiments generally did not find much evidence in support of Ornstein's model, it is more likely the above results reflect between experiment actual duration differences. The overall mean actual duration of the autobiographical events (29 days) is somewhat smaller than the average actual duration of the public events (58 days), therefore the above result may reflect the tendency for duration to be over- and under-estimated for short and long durations respectively.

6.4.4 The Relationship Between Event Dating and Duration Estimation

As noted, some authors have interpreted event dating as a type of retrospective duration estimate (e.g., Ferguson & Martin, 1983; Fraisse, 1984; Furlong, 1951). Essentially, the quantitative response given when dating an event can be transformed into a duration estimate: the estimate being the interval between the assigned date and the time or date when the event was dated. Date responses obtained in Experiment 6, Part a, were, however, not transformed into duration estimates. Despite this, the event dating results obtained in Experiment 6, Part a, are in one respect similar to the duration

estimation results obtained in Experiment 6, Part b, and Experiment 2. Furthermore, there are similarities in the processes proposed to account for duration estimation and event dating.

Duration estimation and event dating appear to be similar in the relationship between actual and assigned values. In Experiment 6, Part a, the logarithm of assigned date was regressed on the logarithm of actual date and an exponents of .96 obtained. This exponent is very similar to that obtained in the regression analysis of the duration estimation data obtained in Experiment 6, Part b (e.g., .86) and indicates a similar tendency for assigned values to vary systematically with actual values. That is, the age of recent and remote autobiographical events was generally over- and under-estimated respectively, and for the autobiographical duration events the duration estimates were generally overestimations for short duration events and underestimations for long duration events.

As noted, the models proposed to account for date and duration estimate responses are also similar in some respects. The discussion of event dating strategies suggests dates are sometimes reconstructed on the basis of generalized event knowledge (e.g., natural temporal patterns: one usually goes swimming in the summer), while the reconstructive model of duration estimation also suggests this reconstructive process is based on generalized event knowledge (e.g., a particular type of event usually lasts between X and Y days).

Overall, there do appear to be similarities between date and duration estimation responses. Furthermore, it can be argued that responding to when questions and estimating the duration of an event involve to some extent similar memory processes.

6.5 Conclusion

The results of this study suggest that retrospective recall frequently involves reconstructive processes. Evidence was found in Experiment 6, Part a, that the date of an event is often reconstructed rather than directly accessed. Similarly, the day of the week on which an event occurred is often reconstructed. Furthermore, the results relating to subjects' failure to remember events because they were too similar to other events suggest that the general details of such events if requested are likely to be reconstructed rather

than directly recalled. Finally, the results of Experiments 2 through 4, and Experiment 6, Part b, suggest that the duration of both public events and autobiographical events are estimated using reconstructive processes.

The apparent frequent use of reconstructive processes when recalling information suggests that one does not necessarily have to remember the required information in order to provide a reasonably accurate response. Subjects in Experiment 2 and 4 that could not remember the public events were able to provide reasonably accurate estimates of event duration. Similarly, the duration estimates of forgotten events in Experiment 6, Part b, were not unduly inaccurate. The accuracy of day of the week and date responses also appears to be somewhat independent of actual event memory. It is, of course, advantageous in terms of response accuracy for the event for which one is trying to recall information about to be actually remembered. But, on the other hand, one probably can be reasonably confident that, for example, a date and day of the week response for an event that can not be actually remembered will be reasonably accurate.

In the course of everyday life, recalled temporal information which is only reasonably accurate may have to be sufficient. Indeed, even where the event for which such information is recalled is well remembered the temporal response is still likely to be inaccurate. If the accuracy of temporal information is vital, one might well be advised not to rely on recall, as on this dimension the memory system will generally fail. Recall accuracy is, of course, not usually vital, a reasonably accurate response will generally meet the requirements of everyday life.

In conclusion, two aspects have been identified as the main features of this thesis, the development of the undirected-diary method, and reconstructive model of retrospective duration estimation. The development of a research method which is consistent with the scientific temper of contemporary memory research , in terms of its high ecological validity, might be considered a significant advance in terms of cognitive science. The reconstructive model of duration estimation, has also perhaps advanced cognitive science, in that it further illustrates the potential of the memory system to reconstruct information, and perhaps makes the concept of time in retrospect more readily interpretable.

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APPENDIX A: Event Descriptions and Associated Duration Questions Used in Experiments 1 Through 4

Event Description and Event Description Abbreviation	Duration Question
(AM) Mr Aldo Moro, former Prime Minister of Italy, was kidnapped by the Red Brigade urban-guerrilla group. Some time later his body was found in the boot of a car in central Rome.	How long after being kidnapped was Aldo Moro's body found?
(SAH) An argument developed over the legality of Sir Albert Henry's election tactics when his Cook Island Party flew a number of voters from Auckland to the Cook Islands to vote. His win in the elections was subsequently overturned and the Cook Island's Democratic Party assumed office.	How long after the election was Sir Albert's party removed from office?
(PPI) The previous Pope of the Catholic Church, Pope John Paul I, died suddenly of a heart attack.	How long did Pope John Paul I reign for?
(PPII) Pope John Paul II went to Poland to visit his homeland. It was the first visit by a Pope to a communist country.	How long was Pope John Paul II in Poland for?

(CD) 'Carless days' were introduced in New Zealand as a petrol saving measure. The restrictions were relaxed on a number of occasions and finally completely withdrawn.	How long after their introduction were the 'carless days' restrictions completely withdrawn?
(A) Landslips at Abbotsford, Dunedin, led to a state of emergency being introduced.	How long did the state of emergency at Abbotsford last for?
(SB) United States officials held a Soviet airliner on the tarmac at New York's Kennedy Airport while they determined whether the Soviet ballerina on board, Lydumilla Vlasosa, was leaving the country of her own free-will.	How long was the plane held at Kennedy airport for?
(OUE) In Iran, students occupied the United States Embassy, taking a large number of hostages. They demanded the return of the Shah who was in hospital in the United States. Some time later the hostages were released and the occupation of the embassy ended.	How long were the United States Embassy hostages held for?
(GMM) In Saudi Arabia 300 armed Shi'a rebels seized the Great Mosque at Mecca. Saudi troops later took the mosque by force.	How long did Shi'a rebels occupy the mosque for?

(PMC) Ex-Beatle, Paul McCartney, was arrested at Narita International Airport, Japan, when customs inspectors alleged they found 220 grams of marijuana in his suitcase. He was later deported.

How long after his arrest was McCartney deported?

(IEL) Gunmen burst into the Iranian Embassy in London and took a number of hostages. Some time later British troops stormed the embassy and freed the hostages.

How long was it until British troops freed the hostages?

(MP) A play based on Maori protest issues, performed at Mangere College by the Maranga Mai cultural group, resulted in considerable controversy.

How long did the play run for?

(TJC) Terrence John Clark, alias Alexander James Sinclair, was tried and convicted in England for the murder of the drug boss Christopher Martin Johnstone.

How long did the trial run for?

(LW) Polish trade union leader Lech Walesa led a solidarity delegation on an official visit to Rome. While he was there he was received by Pope John Paul II.

How long was Lech Walesa in Rome for?

(TPF) New Zealand's agricultural industry was relieved when tests revealed that the outbreak of vesicular disease on a Temuka pig farm was not foot and mouth.	How long was it until the tests revealed that the disease was not foot and mouth?
(PC) The freighter Pacific Charger, on its maiden voyage from Japan, had to be refloated after it ran aground on rocks at Boring Head, southwest of Wellington.	How long was the Pacific Charger grounded for?
(ST) The last South African Springbok rugby team's tour of New Zealand sparked off a sustained and violent protest against South Africa's apartheid policies.	How long were the Springboks in New Zealand for?
(RCF) In New Zealand's first industrial sit-in, 27 women and 2 men, seeking redundancy payments, occupied the Rixen clothing factory in Levin.	How long did the sit-in last for?
(SS) A Soviet submarine ran aground in Swedish territorial waters. Swedish officials detained the vessel. Some time later they released it.	How long did Swedish officials detain the Soviet submarine for?
(F) Argentine Armed Forces invaded the Falkland Islands.	How long did the Argentine Armed Forces have control of the Falkland Islands for?

(MC) A storm traps Mark Inglis and Philip Doole on Mount Cook.	How long were Mark Inglis and Philip Doole trapped on Mount Cook for?
(JD) In Italy, Brig-Gen James Dozier (Nato Deputy Chief of Staff) was kidnapped by Red-Brigade terrorists. Some time later they released him unharmed.	How long did the Red-Brigade terrorists detain James Dozier for?
(AB) Savage bush-fires swept through parts of South Australia and Victoria. Sixty-nine people died and millions of dollars worth of property was destroyed.	How long did the bush-fires last for?
(R) Prince Charles, Prince of Wales, and Diana, Princess of Wales, visited New Zealand with their son Prince William. It was Diana and William's first visit to New Zealand.	How long did the Royals stay in New Zealand for?
(S) The West German magazine 'Stern' announced the discovery of 60 volumes of Adolf Hitler's diaries. Some time later it announced that these were in fact forgeries.	How long was it until the magazine announced that the diaries were forgeries?
(H) More than 2000 people were involved in a hikoi or peace walk to protest against Waitangi Day celebrations.	How long did it take the march to reach Waitangi?

(BDC) Bruce Douglas Cameron escaped from Oakley Psychiatric Hospital and threatened to release nerve gas. This initiated a nation-wide search resulting in his capture.	How long was Bruce Douglas Cameron at large for?
(YF) British police laid siege to the Libyan People's Bureau (embassy) after W.P.C. Yvonne Fletcher was killed when a gunman fired from the building.	How long did the police siege last for?
(GK) Gloria Kong was kidnapped at gunpoint from her Oamaru home. Some time later she managed to free herself.	How long after being kidnapped did Gloria free herself?
(JK) John Kirk left New Zealand for the United States taking a large amount of money with him and leaving many debts behind. These led to his extradition from the United States to face bankruptcy charges.	How long was John Kirk in the United States for?
(W) The Christchurch Wizard resigned after his attempt to ensure the success of the Canterbury Rugby Team with a 'spell' failed. Some time later he returned to the Christchurch Square.	How long did the Wizard's resignation last for?

(BF) A baby, nicknamed "Baby Fae", received a baboon heart in a life-saving transplant operation. However, sometime later complications developed and she died.	How long after the operation did "Baby Fae" die?
(WC) White settlers rioted in New Caledonia over the French Socialist Government's handling of the Kanak (Melanesian) independence movement.	How long did the rioting last for?
(AL) Four Palestinian guerrillas hijacked a cruise ship, the Achille Lauro. Some time later they surrendered and left the ship.	How long were the guerillas in charge of the ship for?
(ND) American reporter Nicholas Daniloff was arrested by the KGB in Moscow and charged with espionage. He was later released by the KGB into the custody of his embassy.	How long was Nicholas Daniloff detained by the KGB for?
(KZ7) New Zealand's entrant in the Americas Cup, KZ7, began the first elimination round in great style, constantly winning its races. However, its race against Stars and Stripes interrupted its winning streak.	How long was it before Stars and Stripes interrupted KZ7's winning streak?

APPENDIX B: Events and Associated True/False Recognition Task Propositions Used in Experiment 1

(R) Prince Charles, Prince of Wales, and Diana, Princess of Wales, visited New Zealand with their son Prince William. It was Diana and William's first visit to New Zealand.

(T) 1. Police were quick to arrest an individual who bared his buttocks in the presence of the Royal couple in Wellington.

(F) 2. The Royals left New Zealand from Christchurch.

(F) 3. As part of their South Island itinerary the Royals visited Dunedin.

(F) 4. No photos of Prince William were allowed during the tour.

(T) 5. Prince Charles announced to a mass rally of Auckland school children that he had arranged a day's holiday for them.

(T) 6. The Royal couple and William arrived in New Zealand at Auckland Airport.

(F) 7. The Royals arrived direct from the U.K.

(T) 8. During the Royals' Auckland engagements the vice-regal Rolls-Royce failed to start.

(F) 9. No mention was made of the Falklands War by the Royals during their visit.

(T) 10. British news media covering the tour protested at the lack of access they had to the Royals.

(TPF) New Zealand's agricultural industry was relieved when tests revealed that the outbreak of vesicular disease on a Temuka pig farm was not foot and mouth.

(T) 1. During the outbreak animal movements between the North and South Island were stopped.

(T) 2. The pigs were fed on garbage from hotels and restaurants.

(F) 3. 5000 sheep, also on the property, were killed.

(T) 4. Specimens from the diseased pigs were sent to England so the disease could be identified.

(F) 5. It was suspected that the pigs may have got the disease from the special 'pig pellets' they were fed on.

(F) 6. The farmer was advised that no compensation would be paid to cover his losses.

(T) 7. Australia placed a ban on the importation of animals and animal products from New Zealand.

(T) 8. More than 750 pigs were destroyed.

(F) 9. Army personnel were used to destroy the animals.

(F) 10. Ministry of Agriculture officials were called to the farm after 27 pigs died suddenly.

(GMM) In Saudi Arabia 300 armed Shi'a rebels seized the Great Mosque at Mecca. Saudi troops later took the Mosque by force.

(F) 1. The rebels killed a number of hostages.

(T) 2. The rebels entrenched themselves in basements of the Mosque

(T) 3. The occupation of the Mosque provoked violent protests elsewhere in the Islamic world.

(T) 4. The rebels demanded that the Muslims recognize one of their number as the new messiah.

(T) 5. Many people were killed or injured when the rebels seized the Mosque.

(T) 6. The rebels held a number of hostages in the Mosque.

(F) 7. The rebels demanded the release of some of their sympathizers in a nearby prison.

(F) 8. The rebels set fire to large sections of the Mosque.

(F) 9. Saudi troops flooded the basements of the Mosque drowning all the rebels.

(F) 10. The rebels took the Mosque during the night.

(BDC) Bruce Douglas Cameron escaped from Oakley Psychiatric Hospital and threatened to release nerve-gas. This initiated a nation-wide search resulting in his capture.

(F) 1. Cameron had the ingredients to make the nerve-gas with him when he was caught.

(F) 2. The antidote to the nerve-gas was being distributed to strategic locations when Cameron was caught.

(T) 3. The Police believed Cameron was capable of making the nerve-gas.

(F) 4. Cameron demanded 500,000 dollars or he would release the gas.

(T) 5. The police first learnt of the threats after Cameron telephoned his Auckland solicitor.

(T) 6. The antidote to the nerve-gas was readily available.

(T) 7. Cameron was reportedly seen photocopying chemistry books in the library at the University of Canterbury.

(F) 8. Cameron was caught at Christchurch Airport.

(F) 9. Cameron escaped from Oakley Psychiatric Hospital by hiding in a rubbish bin.

(T) 10. Cameron had the formulae to make the nerve-gas with him when he was caught.

(H) More than 2000 people were involved in a hikoi or peace walk to protest against Waitangi Day celebrations.

(T) 1. Mrs Eva Rickard was the march leader.

(F) 2. The protest marchers walked across the Auckland Harbour Bridge

(T) 3. A meeting between the Governor-General and the marchers never took place.

(T) 4. Members of the Koahitonga Movement organized the march.

(F) 5. The marchers carried with them a petition signed by 400,000 people protesting against the Treaty of Waitangi.

(T) 6. The march began at Ngaruwahia.

(F) 7. The Governor-General, Sir David Beattie, refused to meet with the marchers.

(F) 8. Many marchers were arrested at Waitangi.

(T) 9. All the marchers wanted to meet with the Governor-General at the Waitangi Treaty House grounds.

(F) 10. The Prime Minister Sir Robert Muldoon addressed the marchers at Waitangi.

(ND) American reporter Nicholas Daniloff was arrested in Moscow. He was later released by the KGB into the custody of his embassy.

(T) 1. Daniloff's assignment was due to end the week following his arrest.

(F) 2. Daniloff's wife was immediately deported following his arrest.

(F) 3. He was held at the KGB headquarters.

(F) 4. Daniloff had top secret plans of military weapons in his possession when arrested.

(T) 5. The USSR officially charged Daniloff with espionage.

(T) 6. His wife was allowed to visit him.

(F) 7. Daniloff's soviet contact was also arrested and charged with spying.

(T) 8. The USA stated that Daniloff's arrest was a set-up in retaliation for the arrest of a Soviet United Nations employee on spy charges in New York.

(F) 9. Daniloff was arrested at Moscow's international airport boarding a flight to the USA.

(T) 10. Daniloff had no diplomatic immunity.

(PMC) Ex-Beatle, Paul McCartney, was detained at Narita International Airport, Japan, when customs inspectors alleged they found 220 grams of marijuana in his suitcase. He was later deported.

(F) 1. McCartney gave a free concert before being deported.

(F) 2. McCartney was entering Japan with his family for a holiday when he was arrested.

(T) 3. McCartney was held in jail after his arrest.

(T) 4. McCartney's wife and four children had accompanied him to Japan.

(T) 5. No tour concerts were played before McCartney was deported.

(T) 6. He was entering Japan with his band 'Wings' when he was arrested.

(F) 7. McCartney was fined 10,000 US dollars.

(T) 8. Commercial and Government owned radio stations in Japan stopped broadcasting 'Wings' songs.

(F) 9. McCartney was placed in the custody of the British Embassy after his arrest.

(F) 10. McCartney alleged the drugs were planted in his suitcase.

(PC) The freighter Pacific Charger, on its maiden voyage from Japan, had to be refloated after it ran aground on rocks at Boring Head southwest of Wellington.

(F) 1. A Southerly storm freed the ship.

(F) 2. All the crew were taken off the ship soon after it ran aground.

(T) 3. Among the ship's cargo were tonnes of car parts.

(T) 4. A salvage expert was flown in from Singapore to survey the ship.

(F) 5. A rescue base was set up in a cave near the ship.

(T) 6. A tug was brought specially to New Zealand to help in the salvage operation.

(F) 7. No sightseers were allowed near the ship.

(T) 8. A causeway was built to the ship.

(F) 9. One crew member was killed when the ship ran aground.

(T) 10. Oil escaping from the ship had little effect on local bird-life.

(SS) A Soviet submarine ran aground in Swedish territorial waters. Swedish officials detained the vessel. Some time later they released it.

(F) 1. As soon as it was freed from the mud the Soviet submarine made for international waters.

(T) 2. The submarine's commander was taken off the submarine and interrogated by Swedish naval experts.

(F) 3. The submarine was hauled off the mud by a Soviet tug.

(F) 4. The Soviet Union made no attempt to salvage the submarine.

(T) 5. Swedish commandos carried out exercises on land near the submarine.

(F) 6. The Swedish authorities confiscated a number of documents from the submarine.

(T) 7. Soviet warships arrived in nearby international waters.

(F) 8. One of the submarine's crew was killed when it ran aground.

(T) 9. The submarine ran aground near Sweden's main Naval base.

(T) 10. The grounded submarine was found by a Swedish fishing boat.

APPENDIX C: General Event Descriptions Used in Experiment 3 and 4

(AM) A prominent politician is kidnapped by an urban-guerrilla group. Some time later his body is found.

(SB) An international flight is detained while officials determine if a foreigner on board is leaving the country of his/her own free-will.

(OUE) A foreign embassy is occupied and a number of hostages taken. Some time later they are released and the occupation of the embassy ends.

(GMM) A group of armed rebels seize a place of religious significance and are later removed by force.

(PMC) A pop-singer is arrested while entering a foreign country on drugs charges and is later deported.

(IEL) Gunmen occupy a foreign embassy and take a number of hostages. Later troops storm the embassy and free the hostages.

(MP) A theatrical production about sensitive political issues results in considerable controversy.

(ST) A rugby tour sparks off protests against South Africa's apartheid policies.

(JD) A high-ranking military person is kidnapped and later released by a terrorist group.

(S) Historically significant documents are discovered but are later denounced as forgeries.

(YF) Police lay siege to an embassy after an individual is killed when a gunman fires from the building.

(GK) An individual is kidnapped but later escapes.

(ND) An individual is arrested and charged with espionage in a foreign country. Later he is released into the custody of his embassy.

	Duration Question for the Ten Selected High Frequency Events.
(PPII) A prominent religious leader made an official visit to a foreign country.	How long did the visit last for?
(A) A natural disaster resulted in a state of emergency being introduced.	How long did the state of emergency last for?
(PC) A ship ran aground and had to be refloated.	How long did it take to refloat the ship?
(RCF) Workers staged a sit-in (occupation) of their factory over redundancy payments.	How long did the sit-in (occupation) last for?
(MC) Climbers were rescued after a storm trapped them on a mountain.	How long were the climbers trapped on the mountain for?
(AB) Savage bush-fires claimed lives and destroyed millions of dollars worth of property.	How long did the bush-fires last for?
(R) Members of a royal family visited a foreign country.	How long did the visit last for?
(H) A large number of people undertook a march in protest against some issue.	How long did the march last for?

(BF) An individual had a heart transplant operation but later died.	How long after the operation did the individual die?
(NC) Individuals rioted over political issues.	How long did the rioting last for?

Duration Question for the Ten Selected Low Frequency Events

(SAH) A newly elected government was removed from power because of corrupt election tactics.	How long after the election was the government removed form power?
(PPI) A prominent religious leader died suddenly from a heart attack.	How long did his reign last for?
(TJC) An international drug boss was tried and convicted of murder.	How long did the trial last?
(LW) A prominent trade union leader led a delegation on an official visit to a foreign country.	How long did the visit last for?
(TPF) A suspected outbreak of foot and mouth disease was reported but tests revealed it to be some other disease.	How long was it until the tests revealed that the disease was not foot and mouth?

(SS) A naval vessel ran aground and was detained in a foreign country's territorial waters. Some time later it was released.	How long was the vessel detained for?
(BDC) A patient escaped from a psychiatric hospital and threatened to release a dangerous chemical. This initiated a nation-wide search resulting in his capture.	How long was the patient at large for?
(JK) A prominent politician left the country with a large amount of money and leaving many debts behind. He was later extradited to face bankruptcy charges.	How long was the politician abroad for?
(W) A prominent community figure resigned but later returned to his job.	How long did his resignation last for?
(AL) Terrorists hijacked a cruise ship but later surrendered.	How long were the terrorists in control of the ship for?